Engineering and Mining Journal

H. C. PARMELEE, Editorial Director
New York: A. H. HUBBELL, H. D. KEISER, Associate Editors
H. H. WANDERS, Market Editor; W. N. P. REED, Assistant Editor
San Francisco: J. B. HUTTL, Assistant Editor; G. J. YOUNG, Consultant
Washington, D. C.: PAUL WOOTON

Volume 136 APRIL 1935 Number 4

Study the Proposed National Mineral Policy

A MINERAL POLICY for the United States is being formulated by the Planning Committee for Mineral Policy, appointed by the President April 7, 1934. Late last year a preliminary report was made, a brief summary of which was published in the January, 1935, issue of this journal. Since then the full report has been printed in a document of sixty pages, and is available for fifteen cents on application to the Superintendent of Documents, Washington, D. C. The metal-mining industry should avail itself of this publication and study carefully the tentative proposals of the Committee. Thereafter it should express its sentiments on the various policies proposed.

We believe the Committee will welcome from the mining industry constructive comment, criticism, and factual information relating to a sound national mineral policy. Its membership comprises representatives of governmental agencies and departments concerned with the conservation and development of our mineral resources. Its preliminary report is based largely on the coordinated views of able and disinterested public officials, supplemented by conferences with some leaders in the mineral industries. But, as stated in the preliminary report, limitation of time made it impossible to extend those conferences as far into the industry as is hoped for later.

We understand that the final report is in preparation and may be finished by June. Now is the time to study the preliminary report and express agreement or disagreement, for it is obviously impossible for the Committee to consult the entire industry. A case in point is the attitude of the West toward the proposed policy regarding minerals on the public domain. The Committee favors extension of the leasing principle to all publicly owned mineral deposits in the United States proper. Western sentiment adheres to the policy of keeping public mineral lands free and open to exploration, discovery, and acquisition in accordance with local custom.

Which is the better long-range policy for development of the mining industry, expropriation of mineral rights for private gain or governmental administration of public mineral resources for the national welfare? The mining industry should register its views, supported by fact and argument. Similar problems arise in connection with those minerals of which we have either surplus or deficiency of domestic supply. What should be the national policy regarding copper, lead, and zinc on the one hand, or manganese, tin, and quicksilver on the other? Each mineral industry should favor the Committee with facts and arguments on which a far-reaching policy can be based.

Other questions of national policy on which the mining industry may offer wise counsel relate to taxation, conservation, tariffs, quotas, trade agreements, cartels, and similar matters discussed in the Committee's report, and on some of which no final conclusions have been reached. *Engineering and Mining Journal* will be glad to serve as a public forum for pertinent discussion of all these important civic and industrial matters.

Copper Conference Reaches Agreement

CONGRATULATE the copper industry! A conference in New York of the principal producers of the metal outside the United States has reached complete accord on a program of production control, marketing methods, and trade practices for a period of three years. Realistically facing the rising tide of copper production in Africa, South America, and Canada, and the capacity of foreign markets to consume the output, the producers cooperated in adopting measures that should stabilize the industry and avoid ruinous competition. Production being in excess of current demand, it will be curtailed about 30 per cent. Statistical information will be developed as an aid to stability. Pooling of sales and pegging of prices will be avoided. In short, for the first time in the history of the industry, conflicting individual interests have been resolved in a constructive three-year program, to develop stable markets and prices.

Stream Pollution by Mill Tailings

COLORADO FARMERS and miners locked horns over the discharge of mill tailings into Clear Creek, water from which was subsequently used for irrigation. The defendant mining company was enjoined from polluting the stream, and it looked as though a blow had been dealt to the mining industry of the entire State. Probably the situation is not as bad as it seemed at first. Reading the Colorado Supreme Court's opinion on rehearing, we find that "the thing enjoined is pollution." And "pollution means an impairment, with attendant injury, to the use of the water that plaintiffs are entitled to make. . . In reality, the thing forbidden is the injury. . . . A primary duty rests upon one introducing such extraneous matter into this stream, to prevent damage from arising from such introduction, either from his acts alone, or in conjunction with those of others. Failing this he must answer at his peril."

In the meantime legislation has been introduced to regulate the pollution of streams, in the interest of both miners and farmers. The incident, however, emphasizes once more that litigation is a poor weapon for parties whose interests are reciprocal if not mutual. A court decision is likely to be rigid and inflexible, strictly in accordance with the law—perhaps an old, unwise law—but without regard to changed conditions and social consequences. Conference and compromise offer the better way out if the contestants are not too obstinate.

NRA and Mineral Industries

WHATEVER the future of NRA, whatever the merits or demerits of the criticism of monopoly, oppression, and restriction of production in manufacture and trade, the fact still stands out that industries based on natural resources such as minerals are in a different category and call for different treatment. Throughout the depression the idea steadily gained acceptance in governmental and mining circles that industries using natural resources—particularly exhaustible resources—should have the sanction of the Government to enter into agreements on production. It was recognized that such agreements would not be in restraint of trade but in the public interest. Further impetus was given to the idea by the report of the National Resources Board, so that it is now well-nigh universally recognized.

So, whether NRA is reenacted or superseded by some other agency, it seems certain that legislation will be enacted that will allow natural-resource industries to make agreements, otherwise unlawful, to stabilize their operations in their own and the public's interest. Louis S. Cates comments on these matters in his annual report to the stockholders of Phelps Dodge Corporation. Referring to the Copper Code he says: "The Code has worked satisfactorily. It has provided for the collection of reliable information that has led to a more intelligent conduct of the business of the industry." And regarding the idea of insuring conservation and preventing waste of mineral resources by production agreements under governmental regulation, he stated: "Some provision of this nature seems necessary in order to avoid destructive competition." Other leaders in the mining industry spoke to the same effect in our January issue.

It may be, as one writer says, that NRA is like Cinderella back in her ashes again after the big party, with no Prince Charming hunting for her with a crystal slipper. But we are much less concerned wth the fate of NRA itself than with the recognition of a principle and adoption of a policy that will stabilize the non-ferrous metal-mining business.

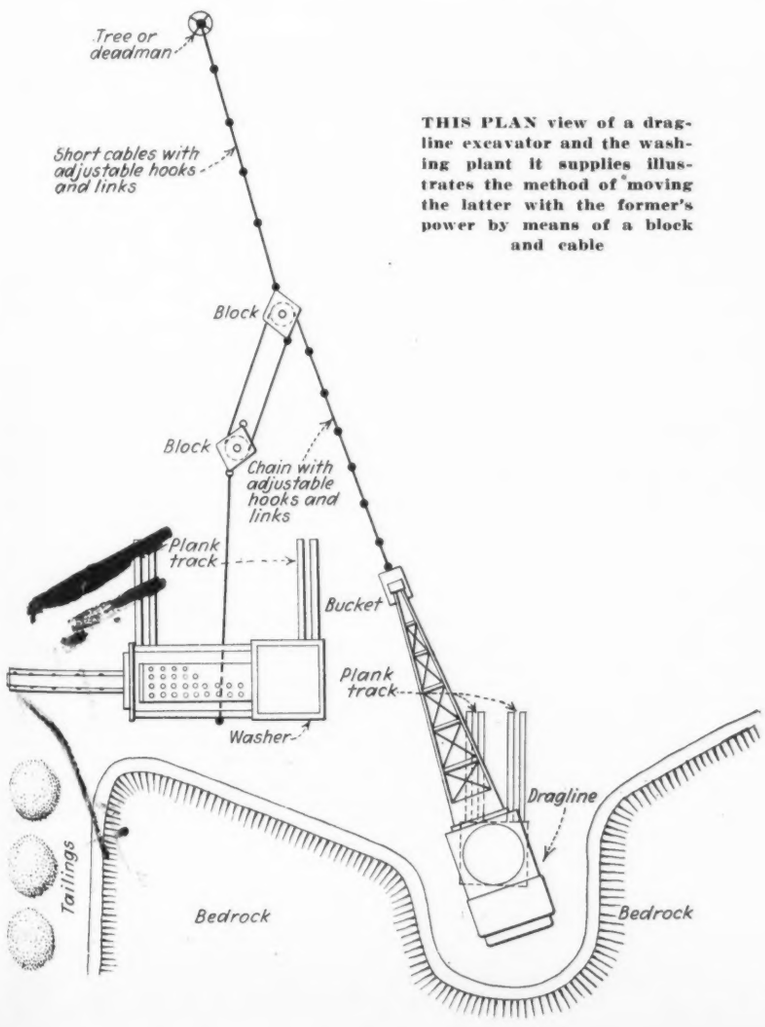
The Dragline Excavator In Placer Mining

Alluvial gold deposits too small for dredging and too low in grade for working by hand afford the operator equipped with this machine a possible chance for profit

The cost of an installation including washing plant and accessories, plus working capital for sixty days, ranges from $25,000 to $50,000, according to the author

S. R. Fox

Mining Engineer,
4009 Harding Way, Oakland, Calif.



THIS PLAN view of a dragline excavator and the washing plant it supplies illustrates the method of moving the latter with the former's power by means of a block and cable

THOUGH the field of profitable placer mining has been much enlarged by the modern dredge and the hydraulic elevator, many areas of placer ground not adapted to their use or to the primitive method of shoveling into sluice boxes still await and invite exploitation. I refer to deposits too small in area and depth to warrant the construction of a gold dredge, or too low in grade to be worked by manual labor. Many attempts to exploit this type of gravel deposit by mechanical methods have been made, only to meet with failure. In this article I purpose to discuss the various kinds of equipment used and to point out some of the reasons that make for high costs and consequent failure. Prerequisites to successful placer mining are careful testing of the gravel, mobility of the digging and washing equipment, and maximum daily average yardage.

Conventional machinery employed on small or shallow placer deposits consists of the digging element, usually a steam shovel or dragline, and a portable or floating washing plant. The dragline excavator to which reference will be made is the type of machine employed by contractors and others in ditch or embankment work on irrigation and drainage projects, and must not be confused with the slip scraper dragline, of which more will be said later. Its place as a successful excavator has been established, and failures with it in placer mining are attributable to inexperience in its use rather than to improper design and construction of the machine. Too many excursions have been made into placer mining by individuals and contractors who have used the dragline successfully in ditch or embankment work, but who did not understand the essential principles of placer mining, so that the end was failure. Advance will be made and much gold recovered once this machine, in conjunction with a proper gravel-washing plant, has been given a chance under experienced operators.

Obviously, the cost of operating a dragline will always be higher than that of running a gold dredge, but I can see no reason why use of larger machines and buckets will not produce costs in line with those of a 2-cu.ft., or larger, dredge. Other factors that tend to offset the higher cost of operation are: (1) Small or shallow placer deposits are nearer the source of gold and are richer than the larger areas worked by the pontoon-type dredge; and

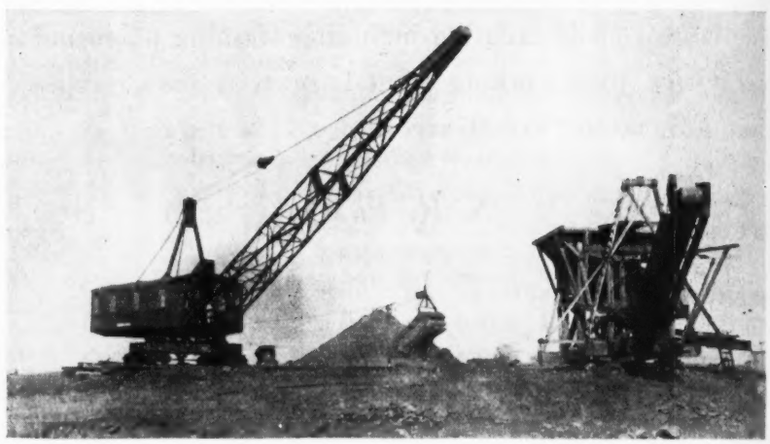
(2) the ease with which the dragline and washer can be dismantled and removed after a given area has been worked out.

The dragline excavator is ideal for working placers where natural obstacles have prevented the use of the dredge, hydraulic elevator, or other placer mining methods. It travels on the surface and can follow the variations in depth of the bedrock, excavate small crevices, move large boulders, and remove such that will enter the mouth of the Page bucket, which measures 3 by 4 ft. and 6 ft. in depth when of 1½-cu.yd. capacity. In many instances it is more advantageous to have the pit men break up large boulders and send the product to the washing plant with the gravel. Large or small ridges of bedrock composed of quartzite or other like rock, if interfering with excavating the pay gravel or softer bedrock, can be broken up manually or by drilling a few shallow holes with a bull bar and loading them with a small amount of powder. Bulldozing large boulders or hard ridges of bedrock is another method frequently employed.

The ideal digging depth for a dragline excavator equipped with a 60-ft. boom is from 15 to 20 ft. Where the gravel will stand up to a slope of 1 to 1, the depth can be increased to 30 ft. Assuming that the end of the boom is at an elevation sufficient to clear a hopper the top of which is 20 ft. above the surface, the distance from the center of the machine to the back of the bucket suspended from the hoisting cable is about 60 ft., which makes possible a cut 120 ft. wide. This depth and width provides sufficient yardage at each set-up to insure a large daily production. The fact that this size of dragline will excavate to 20 ft. and hoist to 20 ft. above the surface, or a total of 40 ft. in one operation, clearly illustrates its advantage over the power shovel. The capacity of this machine is about equal to that of a 2-cu.ft. bucket-elevator dredge, when employing a 1½-cu.yd. Page bucket. Delays and repairs are not as high as for a dredge of the same capacity, according to available records.

Another advantage of the dragline excavator is that the bedrock can be kept free of water by drainage, thus permitting its examination for rich crevices. This is important where gravel deposits lie on slate or similar bedrock. Many rich crevices have been found by pit men after the dragline operator had removed a foot or two of the bedrock. In one case the recovery of a crevice entirely enclosed outbalanced the cost of drainage by a wide margin. In another, in Alaska, where the bedrock was free of water, recovery was about 90c. per square yard more than the highest estimated from test pits and shafts. Undoubtedly, this increase in production came from crevices in the bedrock exposed by the removal of the gravel. I have excavated rich crevices in schist and slate to 10 ft. with a Page bucket, the width of the bottom of the cut being about the length of the bucket. The work is not difficult for an experienced dragline operator. Crevices too small to be cleaned out by the dragline are best worked by hand and the material hoisted to the hopper of the washing machine. Placer deposits, flooded because low grades prevent rapid draining of the water or because of ridges in the bedrock, can be unwatered by using the dragline to dig a drainage ditch.

1



2

Possessing as it does the revolving digging element, the dragline can be operated in any direction and used for diverse work. For instance, it can prepare the ground prior to moving to a new set-up, while waiting for the washer or during other periods of delay, or it can perform some of the work described in the preceding paragraphs. Hand leveling can be done by the pit men before the machine has completed excavation of the gravel in the old set-up. When moving to a new set-up, 30 ft. is a good distance on the average for one move. This can be effected by turning the machine in the direction in which it is to move and setting the bucket between the track. On level track and loose gravel fill the bucket need but nose in about one foot to move the dragline over rollers on planks—a 30 ft. move requiring about ten minutes. On grades of 1 in 20 ft. the time so consumed is correspondingly higher.

Upon arrival at the new site, side excavations can be started before the pit men have secured the machine, by placing angle irons against the rollers. When moving the dragline on rollers and plank track, the grades should not exceed 1 in 20 ft. Machines equipped with caterpillar tread can operate on much steeper grades, which, however, is not advisable, for it may impede the action of the boom, or the position of the washer may not permit clearance of the hopper by the bucket. Where advance must be made over steep grades, it is best to move the machine beyond the proposed set-up, fill up the grade with waste rock, and then move back on the leveled fill.

Many of the dragline operations in California that I have been able to visit recently have attempted to use the small, convertible type of power shovel changed into a dragline excavator employing a 35- or 40-ft. boom and a 1-cu.yd. bucket. This machine is too small. The boom is too short to reach sufficient yardage at each set-up, and

1 Steam-operated dragline, Bucyrus Class 14, mining a bench deposit on Willow Creek, Iditarod district, Alaska. It has a 60-ft. boom and a 1½-cu.ft. Page bucket

2 An electrically operated Browning dragline working a bench deposit on the Merced River, California. It also has a 60-ft. boom and a 1½-cu.ft. bucket

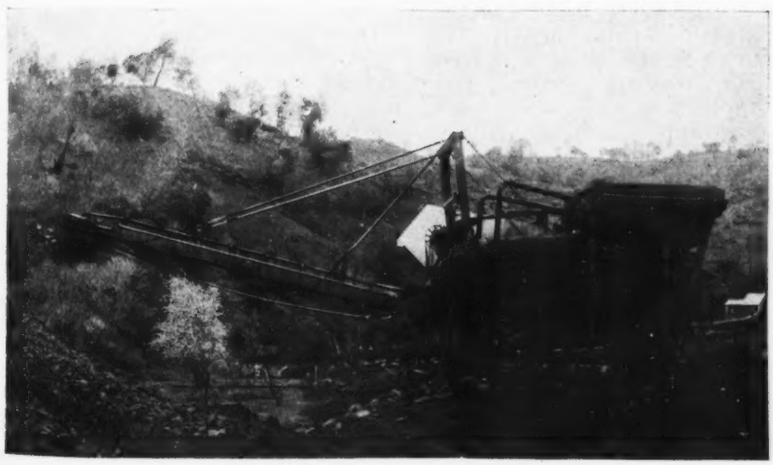
3 A Lidgerwood dragline, in Calaveras County, California. This view shows the width of the cut (120 ft.) and the bedrock after removing 1 to 3 ft. Tailings bank in left center. Gravel bank right center

4 The Lidgerwood Type B dragline close up. It is equipped with a 60-ft. boom and a 1½-cu.yd. bucket

5 The electrically driven gravel-washing and gold-saving plant shown in cuts Nos. 3 and 4. It is moved on plank track with skids and rollers

3

4



5

makes two or three moves necessary to one move when using a 60-ft. boom; further, the bucket is too light to insure efficient digging at depths exceeding 20 ft. The heaviest 1½-cu.yd. Page bucket is the smallest to consider for placer mining work.

In almost all cases of failure the owners have based their plans on the maximum rated capacity of the dragline. This is a serious error and has caused the loss of many thousands of dollars. About 50 per cent of the rated capacity is the limit for a conservative estimate of what the average will be over a period of, say, 60 days. Only the average capacity over at least 30 days should be used when investigating the economic possibilities of a placer deposit to be exploited by a dragline operation. Again, most of the attempts to work gravel deposits with this type of machinery have failed because of a poorly designed gravel-washing and gold-saving plant. Another factor frequently overlooked by the operator and placer miner is the disposal of the tailings.

The washing and gold-saving plant used with the dragline as shown in cuts No. 3, 4, and 5 on this page was designed to meet all problems known or believed to exist in this class of mining. The latest machinery on dredges was studied, including devices discarded in the past. Save for adding several extra braces and changing the water lines on the hopper and in the interior of the trommel, the plant was erected as designed. The washer is compact, and the frame of extra-heavy timbers is strong enough to withstand hard use. It will operate satisfactorily even if not quite level on all four corners. Many of the plants that I have visited in recent years were either too light or too bulky, causing delays and reduction in yardage below economic limits.

The washer consists of a 14x14-ft. hopper made from 4x12-in. planks; a 4½x22-ft. rotary trommel; gold-saving tables and sluices; and a 40-ft. stacker with a 24-in. belt for the disposal of coarse gravel and boulders. The hopper covers the upper end of the trommel to permit dumping large quantities of gravel and thus insure a steady flow of material to the trommel. Chutes leading from the hopper to the trommel are lined with sheet and strap iron, and water connections are available at the hopper to facilitate the flow of gravel into the trommel. A screen with ⅜-in. round holes covers 16½ ft. of the trommel, and one with ¾-in. perforations the remaining 1½ ft. at the lower end, to allow larger particles of gravel to enter the gold-saving tables and prevent packing of the riffles, and to recover large nuggets occasionally found in the gravel. The tables are 5 and 6 ft. wide, divided into four sections for the sluiceways. Total length is 70 ft., of which 55 ft. contain Hungarian riffles. The remaining 15 ft. is covered

with coconut matting and heavy wire screens. The drop between each table reverses the flow of the material, which increases the recovery of gold.

While the washer was in operation at a placer mine in Calaveras County the tailings were tested repeatedly by sluice box and rocker, but the losses were so small that re-treatment by other gold-saving devices was found unnecessary. In fact, three miners were employed at different times without compensation other than room and board and the gold they could recover from working the fine tailings, but none ever stayed on the job more than three days.

Flour and flaky gold constituted less than 10 per cent of the total recovery. This checked closely with estimates based on tests made prior to the installation of the dragline. The last 15 ft. of the tables held less than 5 per cent of the total and not more than half of the flour and flaky gold recovered. The 40-ft. stacker was found to be too short for proper disposal of tailings when the dragline was working in deep limestone crevices. Lengthening of the stacker to 60 ft. was avoided by the use of a small, portable hydraulic giant during the noon hour and after the day's run. The giant was held in place by large rocks and was moved by the horse employed for transporting wood for the dragline boiler. To insure a large daily average yardage, the capacity of the washer should be 20 per cent greater than that of the excavator.

At the Calaveras property, the time required for moving the mechanical equipment, resting on rollers and plank track, a distance of 30 ft. for a new set-up was three hours. The greater part of this time was consumed in adjusting the 10-in. water line and connecting the flexible joint, consisting of a short section of hydraulic canvas hose, between the pipe line and the washer. Moving the dragline and washer proper required only ten and twenty minutes respectively. Use of a slip joint and flexible joints in place of the canvas hose would have reduced the time needed for a new set-up to perhaps one hour. The washer was moved by the simple block-and-cable method explained in the sketch on p. 163.

A large chain with adjustable hooks and links, and short cables with like auxiliaries, were available to facilitate quick adjustments of cable lengths. The pulling line was attached to the bucket of the dragline, and the power required to move the washer was so small that no special blocking of dragline was necessary.

The dragline was operated by a 60-hp. boiler fired with pine wood. Fuel consumption was 1½ cords per shift, and green live oak was used to hold the fire during long delays and over night. Maintenance costs compared favorably with those obtaining in ordinary contract work. Water for the washing plant was supplied by a 10-in. centrifugal pump driven by a water wheel operating under a 300-ft. head. The water wheel also operated a 20-hp. generator, which furnished electric current at 220 volts for the 15-hp. motor driving the trommel and the stacker. The water from the wheel pit discharged into the pump sump, to which also flowed water from a lower water supply ditch.

Total operating costs, determined from the number of buckets dumped into the hopper and including time lost because of ditch troubles, repairs, and other delays, amounted to about 16⅔c. per cubic yard. The full 1½-cu.yd. Page bucket was assumed to contain 1¼ cu.yd. of material in place when dumped into the hopper. Obviously, lower operating costs could have been obtained if the mine had been worked continuously instead of on a nine-hour shift per day.

A Successful Operation in Alaska

Another interesting placer operation is shown in cut No. 1, on p. 164. A Bucyrus Class 14 steam-operated dragline equipped with a 60-ft. boom and a 1½-cu.yd. Page bucket was used to mine a bench deposit in Willow Creek, Iditarod district, Alaska. This deposit was tested by shafts and was considered of too low grade to be worked by a slip or Bagley scraper bucket. I was advised that 75c. per square foot of bedrock was the minimum at which either a steam-operated slip or Bagley bucket could be operated profitably in conjunction with a fixed hopper and sluice boxes. As a dragline operation, the deposit was estimated to average from 35 to 45c. per square foot of bedrock, or about half of the amount required to insure a profit.

In view of the approaching winter season the deposit, measuring about 90 ft. in width, 800 ft. in length, and 5 to 6 ft. in depth, had to be exploited within five weeks. The portable hopper measured 10x20 ft. and was equipped with special roller wheels operating on rounded timber tracks, and the gold-saving equipment consisted of a series of sluice boxes attached to the hopper by a chute. Sheet-iron boxes were used to distribute the tailings over the limited ground available for this purpose. The top of the hopper was about 20 ft. from the ground. Washing operations were impeded by lack of water, which made for low production and high tailings losses. At times only one bucket in five minutes could be handled. It was estimated that 25 per cent of the values were lost in the inefficient washing plant.

Four ten-hour shifts were required to excavate the area reached by one dragline set-up, and six ten-hour shifts to move the hopper and erect the sluice boxes. Despite the low-grade gravel, adverse working condition, and a poor washing plant, the deposit was worked out in five weeks and sufficient money was earned to defray the cost of the equipment, transportation from Seattle and Portland, erection and maintenance of the dragline, hopper and sluice boxes, pay for labor, fuel and sundry mine supplies, and provide an attractive profit.

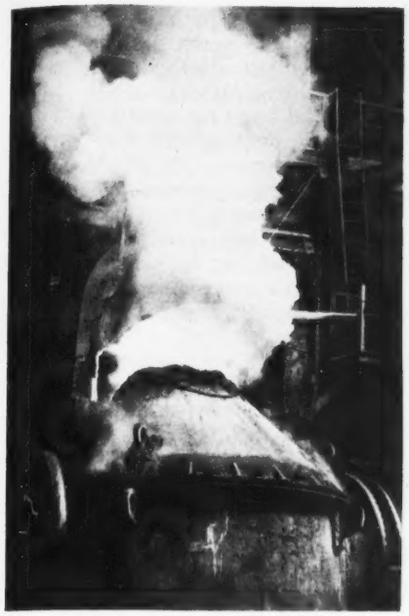
The second illustration on p. 164 shows an electrically operated Browning dragline working a bench deposit on the Merced River in California. The machine was equipped with a 60-ft. boom and a 1½-cu.yd. Page bucket and proved satisfactory for digging the tight and hard bedrock. Unfortunately, the plant operated on a gravel deposit that had been carelessly tested, and the enterprise proved a failure.

A skilled dragline operator should be able to deliver to the hopper one full bucket per minute when operating at an angle of 180 deg., and two buckets per minute when working an area at the side of the washer. Although this speed exceeds the practical average, it is within the capacity of the operator and the machine and must be planned if a high daily average yardage is to be attained. It is advisable that the dragline operator alternately take one short and one long swing. For mining gravel deposits from 20 to 40 ft. deep, a dragline fitted with an 80-ft. boom and a 3-cu.yd. bucket should be used. The steam or electric dragline gives better service at placer mines where the gravel is tight or the bedrock has to be excavated than does the machine powered with an internal-combustion engine, for the reason that the latter has not the power to hold, shake, and loosen large boulders and other obstructions.

The cost of a dragline installation, including working capital for 60 days, camp, fuel, water, and other items, ranges from $25,000 to $50,000. The working crew usually consists of a superintendent, the operator and fireman on the dragline, one man at the washer, two pitmen, a blacksmith, and one man for hauling fuel. Several attempts have been made to use a washing plant mounted on a scow or barge, with the dragline operating in water. The arrangement has not been satisfactory, because the plant is in the way of the operator handling the bucket and the presence of water makes it difficult to clean the bedrock.

Other excavating machinery employed in placer mining with varying success includes the slip or Bagley scraper, used successfully in Alaska for removing shallow frozen gravel; the power shovel; the stiff-leg derrick operating a Page dragline bucket; the bulldozer—a caterpillar tractor equipped with a scraper blade; and the clamshell bucket, but space limitations make impossible detailed description of them.

To avoid the risk of failure, the owners and prospective operators of gravel deposits will do well to employ, exclusively, equipment made by reliable manufacturers, and which will meet the requirements as to bedrock and the character and size of the gravel.



A Great Falls converter in the Clarkdale plant. Smelting coarse pyritic ore and dezincking the molten charge

Recovering Zinc From Copper Smelter Products

Research by United Verde yields a pyrometallurgical process for dissecting heavy sulphide ores—Many interesting possibilities

O. C. Ralston, *Director of Research*
M. G. Fowler, *Research Metallurgist*
C. R. Kuzell, *General Superintendent*
United Verde Copper Company
Clarkdale, Ariz.

OCCURRENCE of both copper and zinc in heavy pyritic ores is quite common. The usual procedure in the past has been to exploit the deposits for their content of copper and precious metals. Only later is any attempt usually made to recover the iron, sulphur, and zinc, which are of only minor value, if valuable at all. In the most favored localities close to markets for these products they have proved of even greater value than the copper, but in general the zinc, iron, and sulphur are not assets. The Tennessee Copper Company, in southeastern Tennessee, affords a classic example of a cupriferous pyrite mine in a favored locality which has been able to market them.

The research and development work done by us on the United Verde ores at Clarkdale were conducted in the hope that, despite its unfavorable location, sufficient metallurgical improvement and economy might be possible in the recovery of the products mentioned in the foregoing, to make them of commercial importance. The processes worked out during the past six years probably have greater value from other viewpoints than that of recovering zinc and are doubtless of much greater value in other localities than they are in Arizona. In view of the interest in this work, therefore, and the patents which have been issued to protect it, a brief résumé is presented, discussing the subject from the viewpoint of zinc. We have found that changes adapted to zinc recovery are possible in copper smelting and are glad to make them public.

The United Verde ore is microcrystalline and not amenable to separation of the zinc and copper products by flotation, and therefore it cannot be treated by any orthodox concentration process now in use. Adoption of Tennessee, or Flin Flon, or other practice is impossible. Hence this research in smelting.

Desultory experiments were made by two of the authors of this paper several years before the formal research program was started. They determined that at least a part of the zinc in a zincky charge can be fumed off in a copper converter and the zinc oxide fume recovered. On this basis, more exact conditions were studied by using one of the 12-ft. Great Falls converters in the Clarkdale smelter. Starting with a ladle of molten matte, poured into a hot converter, small charges of heavy pyritic ore containing both copper and zinc were made, with intermediate periods of blowing to bring the temperature back up and smelt the ore. Use of an optical pyrometer showed that temperature was a very important factor. Dense fumes of zinc oxide formed only above 2,100 deg. F. and with increasing temperature the density of fumes increased. With a total of 5 to 7 per cent zinc in the charge, over half of it could be fumed off before the matte was converted into white metal (cuprous sulphide). At this point, most of the remaining zinc was in the molten iron oxide product resulting from burning the ore. This result was accomplished without using any fuel whatever, except the heat of combustion of the ore itself. The precaution needed was to feed the ore in small batches to avoid chilling. Later, preheated blast was tried and found of great advantage, but not absolutely essential.

Laboratory studies under more closely controlled conditions were then undertaken. Various gases were blown through small charges of molten matte, slag, or mixtures of the two. Air, steam, nitrogen, hydrogen, carbon monoxide, hydrocarbon gases, producer gas, oil gas, and mixtures of coal dust with air were tested either as carrier gases of zinc fumes or as reducing agents to reduce the zinc to metal vapor. We knew that lead smelter slags were being dezincked under commercial conditions elsewhere, using mixtures of air and coal dust. At first, we believed that all we had to do was to adapt such practice to the dezincking of copper smelter products, or to use it to finish up the dezincking that was partly performed in our "self-smelting." It soon became apparent that the problem was more complicated, and a study of the difficulties ultimately brought about a simple solution that has many advantages over the dezincking methods applied to lead smelter slag.

The important products made in a copper smelter are slag, matte, and blister copper. Several classes of matte and slag must be considered. The matte may be the usual mixture of iron and copper (also zinc) sulphides, or at a later stage it may be the white metal from which all iron has been eliminated by burning in the converter. The slag might be ordinary reverberatory slag or it might be several types of converter slag. Whereas the reverberatory slag from a heavy pyritic ore is usually a ferrous silicate containing small amounts of lime, alumina, and other minor constituents of the ore, a converter slag usually has much less silica and therefore carries iron oxides in free form, usually as magnetite. By entirely withholding siliceous flux from a converter the iron in a matte can be burned to a molten iron oxide product containing both ferrous oxide and magnetite, and on continued blowing this unfluxed mass becomes molten magnetite, a material of high melting point. Ferrous oxide has a moderate melting point and good fluidity and is much better adapted to the purposes in view.

All these products were melted in the

WHAT THE NEW PROCESS DOES:

1 **It eliminates the necessity of roasters and reverberatory or blast furnaces and smelts coarse pyritic zinc-copper ore direct.**

2 **It avoids the use of fuel for smelting and supplies sufficient waste heat to provide all power necessary for the process and for preheating the air blast.**

3 **It permits a zinc vaporization of 50-60 per cent in the form of high-grade zinc oxide fume containing most of the other volatile elements of the ore, when no fuel is used and molten copper is not recirculated. (But copper recovery is likely to be low)**

4 **By it, copper can be separated with good efficiency, if enough fuel is used to reduce magnetite to ferrous oxide.**

5 **It requires no flux and yields a molten iron oxide which may be further refined by gaseous or liquid-reducing agents to give a product suitable for making high-grade iron with simultaneous recovery of all remaining zinc as an oxide fume.**

6 **With it gases containing no air and about 14 per cent SO_2 can be segregated for producing elemental sulphur.**

laboratory and blown with various gases. Single materials and mixtures were tried. The results were then translated into a special test plant built with an old barrel-type converter holding 5 to 10 tons of molten charge and with cooling flues and filtering bags to catch the fumes. Final tests were made in one of the Great Falls converters of the smelter, they being capable of taking up to 25 tons of charge.

Using ore containing 5 per cent copper and 6 per cent zinc, the remainder being mainly pyrite, we determined that molten copper could displace part of the zinc from a charge of molten matte or slag, but that about five parts of copper to one part of zinc were required to give the maximum dezincking in the presence of an inert gas—namely 75 per cent dezincking. This is more or less parallel to a much better known reaction of metallic iron on zinc sulphide and zinc oxide. By using either more or less copper the recovery was not so good. Apparently, therefore, the action of copper would have to be supplemented by some reducing gas.

Use of Reducing Gases

Zincky slag alone was treated with reducing gases on the assumption that some zinc was present in the slag in oxide form, although it was known that zinc sulphide is also soluble to a certain extent in the slag. Reducing gases were expected to reduce zinc oxide to metal and also to reduce iron oxide to metal, and the metallic iron would then attack zinc sulphide and liberate zinc vapor. It was possible to get a very satisfactory vaporization of zinc if the temperature was above 2,100 deg. F., and the reaction was quite rapid and efficient if the temperature was above 2,400 deg. F. However, trouble due to reduced iron sticking to tuyeres and walls occurred, and in general the fog of reduced iron stiffened the mass of slag. Better work. if anything, was obtained if silica were kept out of the charge and the slag approached nearer the composition of molten iron oxides. Most of the zinc fumed off in the first few minutes of treatment, but complete vaporization came only with prolonged blowing with reducing gas and very inefficient use of the reducing agent toward the end of the blow. With hydrogen used as the reducing gas, only 4 mols H_2 were needed per mol zinc vaporized when the net vaporization of zinc approached 99 per cent. With carbon monoxide over 14 mols were required.

Using molten matte alone, conditions were not good. Copper matte contains as much as 10 per cent iron oxides in solution, and there was always a first easy evolution of zinc vapor while this iron oxide was being reduced to metal and the metal reacting with zinc sulphide. After that, the reduction seemed to be mainly a slow vaporization of zinc sulphide, followed by its oxidation at the mouth of the converter. Some reaction of hydrogen or carbon monoxide with zinc sulphide, forming gaseous sulphur compounds and zinc vapor, may have taken place, but the net effect is the same. High temperatures favored the dezincking.

By treating both matte and slag together, especially when enough preliminary oxidizing had occurred to assure presence of some iron oxide in the slag, very much better results were obtained. The stiffening of the mass was not noted, and inasmuch as matte is a solvent for metallic iron, it was evident why this was so. Much less punching of tuyeres was needed. Some alteration of oxidizing and reducing conditions appeared to be needed. Mechanically, simultaneous treatment of slag and matte is much more preferable and incidentally is more economical of fuel. This fact might well be adapted to the dezincking of lead smelter slags.

The facts cited were developed both in the laboratory and in the special dezincking plant. The procedure which combined most of the desirable points was to feed ore slowly into a molten bath containing sufficient excess heat to dissolve and smelt the feed, blowing air through the bath all the time to keep up the temperature. By this means, at least partial oxidation is possible before reduction is started. Alternate oxidation and reduction tests were conducted. Following the lead-slag dezincking methods, mixtures of air and coal dust were blown through the bath, and rapid fuming of zinc took place at first. By the time the bath was reduced to 2 per cent zinc the consumption of fuel had become prohibitive. We also found that the tilting furnace (in this case, a copper converter) was more convenient than the stationary furnace used by the lead smelter men, on account of greater ease in handling tuyere troubles. Better fuel economy resulted if a second row of tuyeres was used above the bath to introduce air for combustion of excess reducing agent and zinc vapor and to permit direct radiation of the heat from this combustion on to the surface of the molten bath. This latter point was involved in one of the patent applications.

Installation of Preheater

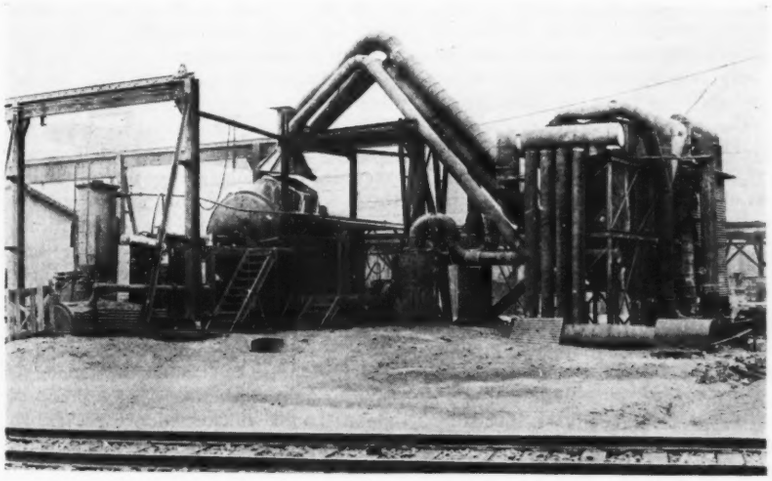
One of the final procedures adopted as preferable was then tested thoroughly in two Great Falls type converters in the Clarkdale smelter, after adapting them for the test. A preheater for the blast was installed, capable of heating the air to as much as 500 deg. C. but usually operated at 300 deg. C. Crude ore was crushed to 2-in. size and placed in a bin over a drum feeder operated with a variable-speed motor controlled from the operating cab of the converter. Slow, continuous feed of the crude ore was then maintained as soon as the small batch of molten material in the bottom of the smelting vessel was up to temperature. If the temperature dropped too much, arrangements were available for gas or oil heating, but with practice the necessity of this precaution became remote. The first stage was therefore "self-smelting" at a temperature adequate to keep the mass molten, but not essentially above 2,100 deg. F. As the vessel filled, charge was cut down and temperature allowed to rise above the critical 2,100 deg. F. Zinc oxide fume rolled copiously from the mouth of the converter, although the samples of converter gas withdrawn from below where air reached the gas contained no oxygen and contained about 13 to 15 per cent SO_2. This gas was calculated to be amply hot to preheat the blast and to raise enough steam to carry on the operation. It was inconvenient to prove this by installing boilers and heat exchangers in the flues of the converter aisle of the Clarkdale smelter.

When zinc oxide fumes began to die down, we found that the SO_2 content of the gas was also diminishing and the magnetite content of the molten iron

oxide "slag" was also rising. If desired, the vessel may be tipped at this point and the molten iron oxides separated as well as possible from copper matte, but due to the specific gravity of the iron oxides the separation is not very satisfactory. It is preferable to proceed without such separation and burn all molten ferrous oxide to magnetite. This reaction is a tremendous source of heat, and the temperature becomes exceedingly high. Only a magnesia lining in the furnace could withstand the severe conditions. The last traces of sulphides are burned, and a molten magnetite product results containing only the adventitious gangue of the ore. If desired, sufficient lime rock can be fed during smelting to flux the silica and alumina of the gangue and leave the molten magnetite in condition for complete reduction to metallic iron.

Fuel Used at This Stage

At this point over half the zinc of the charge has been vaporized, together with all the lead, cadmium, and other volatile elements. All copper has burned to cuprous oxide, and to recover it the molten magnetite must be reduced back to molten ferrous oxide. This is the point where fuel enters the picture for the first time. Any reducing gas is suitable, such as gaseous hydrocarbons or producer gas, only mild reducing conditions being needed, and again it is well to blow air into the vessel above the bath to burn excess combustible gas and heat the bath. The operation is spectacular. The roar of the flame is deafening; the flame is intense; clouds of zinc oxide roll once more; the last of the volatile elements vaporizes; and in the end only a small fraction of 1 per cent of zinc and traces of indium remain in the molten FeO. By the time the zinc oxide fumes die down, the copper is all reduced, and in only a few minutes' settling the bath above contains no more copper than is normally lost in reverberatory slag. The copper layer contains about 98 per cent copper, the remainder being mainly iron and precious metals.



Dezincking test plant, United Verde Copper Company, Clarkdale, Ariz. It includes a blast preheater, producer-gas equipment, a coal-dust feeder, a barrel converter, a fume hood, cooling flues, and a baghouse

Treating the Fume

When the hot gases from both the oxidizing and reducing stages have been cooled, they are filtered in a baghouse to recover the fume. This fume consisted mainly of zinc oxide, carrying all the lead, cadmium, arsenic, antimony, thallium, germanium, selenium, and similar volatiles, and (strange to say) cobalt. It also carries up to 2 per cent of copper. The fume is easily and completely dissolved in the electrolyte of an electrolytic zinc plant. At Clarkdale a small test electrolytic zinc plant was operated for about eighteen months, producing electrolytic zinc from fume, with an extraction of over 98 per cent. The leaching step with fume is easy; only the purification step is difficult. The residue from fume of Jerome ores contained over 25 per cent lead, whereas the crude ore contains only vanishingly small amounts of lead, and also any precious metals vaporized, silver being concentrated into the fume more than gold.

During purification the volatile elements can be divided into as many fractions as desirable. At Clarkdale, recovery was made of selenium, cadmium, and thallium, and the cobalt was passed into the copper precipitate, from which it is recoverable during the normal refining of the copper. Special purification processes had to be developed, but no serious difficulties were encountered, and it was possible to make 99.99 per cent zinc. With solutions pure enough for this, it is possible to deposit zinc on thin, electrolytic zinc starting sheets and build up slabs ¼-in. thick with good current efficiency. For thicker sheets the current efficiency falls off, but fair results were obtained with slabs built up to ¾ in. thickness. Thanks to the long time interval without stripping labor and the high recovery on melting, and the saving of aluminum cathodes, the figures indicate a minimum saving of $2 per ton of electrolytic zinc slabs by the use of starting sheets.

The filtered gases from the oxidizing step, containing 13 to 15 per cent SO_2 and no oxygen, arsenic, nor other impurities, were ideal material for sulphur recovery, reducing the SO_2 to sulphur with natural gas on a suitable catalyst. A pilot sulphur plant was also operated on converter gases for about a year.

Most of the process described in the foregoing had been worked out when the shutdown of the Clarkdale smelter was enforced by depression conditions. Certain engineering problems remain to be tested, such as operation of waste-heat boilers and air preheaters with the hot gases from the fuming furnaces. Fortunately, waste-heat boilers have since then been installed at the lead-furnace slag dezincking plant of one of the lead smelters.

Pyrometallurgical Dissection

Without trying to crowd too many details into this story, or to introduce a discussion of all the possible applications of the metallurgy herein described, it is evident that the development work at Clarkdale has brought out a pyrometallurgical dissection process for heavy sulphide ores which has the following interesting possibilities:

1. It eliminates the necessity of roasters and reverberatory or blast furnaces and smelts coarse pyritic zinc-copper ore direct.
2. No fuel is needed for the smelting and waste heat is available in sufficient supply to afford all necessary power for the process and to preheat the air blast.
3. When no fuel is used and molten copper is not recirculated the zinc vaporization is 50 to 60 per cent in the form of a high-grade zinc oxide fume containing most of the other volatile elements of the ore, but copper recovery is likely to be low.
4. By using enough fuel to reduce magnetite to ferrous oxide, copper can be separated with good efficiency.
5. No flux is necessary and a molten iron oxide product is made which may be further refined by gaseous or liquid reducing agents to give a product suitable for production of high-grade iron, and simultaneously all remaining zinc can be vaporized and recovered as an oxide fume.
6. Gases can be segregated containing no air and about 14 per cent SO_2 as raw material for production of brimstone.

Many individual aspects of the process described, some of them adaptable to use in copper smelters with little change in equipment and without regard to zinc recovery, have not been discussed herein, as space limitations prevent their consideration in this article.

The Tin Problem In the United States

Advantages and limitations of various proposals regarding the supply and prices of this strategic metal

R. S. McBride
Washington, D. C.

TIN is a metal of great importance to its users in the United States in times of peace. It is a strategic material of first importance from the standpoint of military preparedness. For both reasons, solution of the tin problem as it confronts our domestic industries today is important.

Washington is trying to solve this problem. A special committee of Congress has held extended hearings and is now attempting, with the aid of its metallurgical investigator, to bring order out of the varied and conflicting suggestions which have been submitted. In this article I will undertake to analyze some of the outstanding suggestions and point out the major advantages of several that may perhaps be brought together to form a national program.

Consumers of tin in the United States, and they are legion, want a sure supply of tin with reasonable price stability. In most cases cheaper tin is not so important as is a dependable supply at a stable price. Some elements, rather of the speculative type, gain or think they gain from the fluctuation in tin price; but, by and large, these are a minor part of the group for which solution of the problem need be sought by the Government.

Foreign-government-managed Cartel operations make this problem of pressing importance and justify American Government action. But the participation of the Government need not be, and preferably should not be, to the extent of entry into the business. There is need, however, for the Government to set up first a policy and then a legislative foundation for commercial action.

Many special objectives are served by the various spokesmen who have appeared at the Congressional hearings. Some of these seemingly had a narrow outlook and a selfish purpose. Some clearly wish to grind their axes with Uncle Sam turning the grindstone. Among those objectives sought which are not necessarily of national importance are: (1) Stimulation of local tin-mine development in the United States; (2) financing of tin operations; (3) salvaging of unfortunate investments in tin enterprises, some domestic, others abroad. These and other like objectives, though natural, can properly be discarded by Congress in fixing its national policy.

Much of the argument which is made to appear persuasive today proceeds from the assumption that tin-smelting facilities should be established in the United States. Those who believe that, argue theoretically that stability in supply and substantial reserve stocks of tin, either in ore or as metal, can be insured only when American capital on American soil operates a substantial part of the smelting capacity needed to supply United States tin users. This argument is not universally accepted. However, it deserves analysis from the standpoint of practicability. For example, it is logical to ask "How many smelters?" "Under what control?" and "How financed?" Experienced technical proponents of this idea say that several smelters should be established, each with a metal capacity of 10,000 tons per year or more. They insist that American smelting-company capital is ready and anxious to go into this business without money aid from the Government. They insist that only a continuous ore supply and an assurance of a small market margin are necessary to stimulate such commercial investment and the regular operation of such smelters.

Tin ore produced almost wholly in Cartelized areas goes to Cartel-controlled smelters. This altogether prevents American smelting operations at present. United States ore supplies are negligible in quantity, and there is no prospect that they could become adequate to run a single good-sized smelter even if all the present mining prospects could be stimulated to simultaneous operation.

Some inducement must, therefore, be assumed for diversion of ore from present foreign sources, such as Bolivia, Siam, or other sources, to the United States if any smelting development is to start. The most rational proposal to secure such ore movement is based on a consumption tax. This tax, according to its proponents, would be collected on metallic tin at the time of first usage much as is the processing tax on Philippine coconut oil. Tin produced in domestic smelters and secondary tin would, of course, be exempted. If the tax were adequate in size, foreign ore producers obviously would prefer to bring their ore into the United States to permit marketing of the metal here without a tax, rather than to take the smelting profits in present establishments.

Two main obstacles to the accomplishment of this plan are evident. First, heavy export taxes in many important tin-ore producing nations would preclude diversion of ore to United States smelters from such sources. Second, the bonus for domestically smelted tin would have to be quite large in order to induce ore imports from other nations where the ore production now moves normally to smelters of affiliated ownership.

Under these two handicaps there is grave doubt whether the proposed scheme could induce import of enough ore to permit commercial smelting of tin without substantially raising the price of the metal to American users. No specific proposal as to the size of the bonus has been made by the advocates of this plan. But if one assume that 6c. a pound were offered as a bonus (the potential rate in the tariff law), it seems safe to conclude that this would not bring much ore to the United States, although it might raise the price of tin by nearly an equivalent amount.

Proponents of the domestic smelter plan recognize these complications, but have not yet presented a plan adequate to escape them.

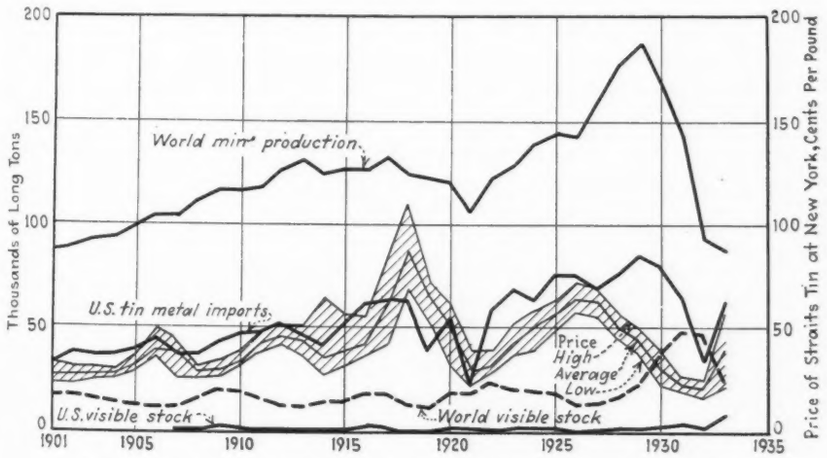
At present tin and tin ore are both on the free list, but if domestic production should reach 1,500 tons per year, the tariff law would apply 6c. per pound to the metal and 4c. per pound

to ore. Under the present circumstances, there is little likelihood of this tariff becoming effective, since proved domestic resources are wholly inadequate to supply even that small proportion of the United States' total needs. (The named quantity, 1,500 tons, if calculated all as metal, is about 2.5 per cent of the typical import requirement of virgin tin.)

Under these circumstances it is evident that no new tariff differentiating between tin and tin ore would probably be adequate to establish tin mining in the United States, unless the rate on metal were made so high as to occasion excessive rise in domestic prices. Hence some other method for stimulating domestic activity is necessary.

A bonus for domestic ore production has also been proposed by some who favor furtherance of domestic mining. They argue that although a tariff might easily raise the price of tin to users by many times as much as the gross value of the domestically produced metal, they believe a bonus would not. The main obstacle to such a plan is that Congress rightly fears the establishment of production bonuses, lest they become a continuing heavy burden on the federal treasury.

The only way to meet such objection to a bonus is by fixing a sliding scale



Trends in production, imports, stocks, and prices of tin, 1901-33. United States Bureau of Mines "Minerals Yearbook," 1934

under which the payments would decrease per pound as the total production increased. This, in effect, would give greater aid to the infant unit than to the growing child, and virtually no aid when the industry became adult and presumably able to meet international competitive conditions without subsidy. Another alternative of like purport would give a bonus for a limited period of time, starting, let us say, with 6 or 8c. per pound initially and stepping this down penny by penny each few years in the hope that after ten or twelve years no remaining bonus would be required.

Unfortunately for domestic advocates, none of these plans seems to have prospect of success; nor of adoption, for that matter.

Geological Surveys

At present the proved tin resources of the United States are extremely small, and negligible commercially. Some think that this represents lack of knowledge; others argue that it is a correct picture of the economic situation. Some neutral observers argue that perhaps there should be a systematic all-encompassing inquiry covering several years which might require extended geological reconnoissance in many areas, and a little core drilling or careful local study of rather large cost in a few areas shown by reconnoissance to be most promising.

Such a study might be much like that made by the United States with respect to potash in the Southwest, but it would have to start with a wider geographic scope and much less certain knowledge as to the prospects for success. In a period of five years such an inquiry might cost a million dollars. But even so it is much less dangerous than any type of tariff or bonus, since it will not, in any event, raise the price of tin, and may conceivably give tin users real benefits if conducted by career men of the United States Geological Survey.

They who propose such studies, of course, recognize that the Government would have to have an understanding with land owners whose reserves were investigated as to repayment to the Government in case paying discoveries should develop. Probably the best plan would be analogous to that used under the Mineral Leasing Act for public lands in which the Government actually takes some royalty. In this case, a share of the production or a share in the gross sales for a limited initial period, or minimum cash compensation, could easily be arranged as each circumstance might indicate to be most equitable. The ultimate object in any event would be to establish definitely what reserves this country has and how they may be developed, if at all—and at what cost.

Another basic inquiry much more needed as a part of our national policy is an extended research on the present uses of and prospective substitutes for tin. And the problems of scrap recovery also deserve study. This unquestionably should be an undertaking under Government control, probably financed largely by Government funds. Here again a million dollars would not be too much to spend. Indeed, a half million dollars a year for ten years might prove a most profitable investment for the country.

Metal Reserves

Regardless of details which may result in new smelting facilities or research which may prove new ore resources or new possibilities in tin utilization or effective substitutes, there will still remain an urgent need for a balance-wheel stock of tin within the United States. It appears certain that a stock of at least 60,000 tons of metal, preferably a minimum of 100,000 tons of metal, above present stocks, would be desirable for this purpose. Either pig tin or ore of equal metal content would serve if American smelters were available.

On the score of propriety, an official objection to the plan of buying and stocking tin in large quantities with Government ownership or control has been definitely expressed. The nominal basis for this opposition is that such an action would appear as a warlike gesture. The real basis for opposition is varied, including among other factors the feeling that the Government should not go into price stabilizing business on behalf of domestic industry.

There is no objection, however, on the part of officialdom, to the building up of such stocks in commercial hands. The only unselfish opposition is that which originates in fear of the financial burden which the building and holding of such a stock would occasion. Other objections come domestically from those who wish to speculate in tin and those who fear that a successful tin-purchasing pool would stifle both domestic smelting and United States mine development.

Close students of the tin situation argue that the United States users of tin should imitate other nations in pooling their needs for tin and by buying through a single corporate agency. It would be most logical under our Governmental system that this should be done by a privately controlled corporation. And it should, of course, be owned and managed principally by the large United States consumers of tin. If

such an enterprise went into the world market armed with orders for all principal domestic users, it could make purchases more advantageously than they are now made by any purchasing group alone. It would be the potential buyer of roughly half the world's output of metal. As such it could almost dictate terms of purchase even to the Cartel. If it proceeded vigorously but not ruthlessly, it could soon build up a sufficient stock of tin in United States hands to insure stability of price. This result would come about because at any time when the tin price advanced abnormally, the Tin Pool could withhold its current orders, and when prices were lower it could resume buying. By this means some estimate that it would soon save 5c. or 10c. a pound for American tin users. Whether that reduction in the world price would come is, of course, uncertain. But there is no doubt that such a plan would slow down any tendency to price increases, perhaps even prevent them altogether for some years.

Such a Tin Pool could logically be partly financed with a low-cost Government loan. But some of the capital should come from the private interests interested in buying metal, and all participants should, of course, go into the enterprise with irrevocable commitments to stay in the Pool until it was dissolved. With proper planning it appears likely that such an enterprise could keep the carrying charges on the metal low enough so that the cost of joint buying would be more than offset by the decrease in price of the metal. The enterprise would then be a direct financial success, as well as an instrument of price stability.

There is grave question whether tin for such a Pool would come voluntarily from present Cartelized producers. They would lose their principal leverage on the United States market if this country had a sufficient reserve to run it for even six months to a year, and, therefore, could temporarily stop buying at any time when the price was advanced significantly. And in this connection it is quite clear that the Cartel is anxious to advance the present world price, perhaps 20c. or 25c. more per pound, as rapidly as its managers think the market will stand this without significant curtailment of current use. Such advance would, of course, be impossible during the year or two or three in which the accumulation of a reserve Pool in the United States was going on, since use from stock, rather than building up of reserves, would immediately begin if the price were advanced significantly.

Very practical difficulties lie in the way of operating such a Tin Pool under any ownership, unless the movement is a part of a coordinated program which is so well balanced and so well backed by the United States Government as to insure success despite the Cartel government's opposition.

It has been reported that American interests holding potential tin properties in Bolivia, but not actively identified with the industry, would like to salvage their investment at the expense of the Government by having the United States buy tin from this source under a deal that would provide even for the servicing of defaulted Bolivian government bonds. Perhaps some have had the idea that so fantastic a scheme could be enacted by Congress in the guise of a tin program; but that now seems unlikely, especially in view of the prospective difficulty of securing any arrangement under which the United States could be sure of getting large and continuous supplies of metal or ore from Bolivia while the present military and economic difficulties of that country continue.

Incidental benefit to the United States holders of Bolivian tin investments and United States holders of Bolivian bonds may come about *quite indirectly* from a forceful forward-looking tin program as a whole. If so, that will be a by-product benefit, but should not under any circumstance become a primary purpose.

Salient Statistics for Tin in the United States, 1924-33

United States Bureau of Mines, Minerals Yearbook, 1934

	1924-28 Average	1929	1930	1931	1932	1933
Production:						
From domestic mines, long tons	18	35	15	3.7	0.4	2.4
From secondary sources, long tons	30,062	30,625	23,393	17,679	13,170	19,732
Imports for consumption, long tons	73,595	87,127	80,734	66,064	34,819	63,718
Exports (domestic and foreign), long tons	1,546	1,930	2,233	(a) 1,661	(a) 1,116	(a) 1,041
Monthly price of Straits tin at New York:						
Highest, cents per pound	70.67	49.37	38.91	27.07	24.76	53.07
Lowest, cents per pound	42.72	39.79	25.27	21.35	19.24	22.70
Average, cents per pound	57.65	45.19	31.70	24.46	22.01	39.12

(a) Foreign only. Domestic not separately recorded.

Tin Content and Value of Secondary Tin Recovered in the United States, 1924-33(a)

United States Bureau of Mines, Minerals Yearbook, 1934

	Recovered at Detinning Plants			Recovered From All Sources			
					As Alloys and		
Year	As Metal (Long Tons)	As Chemicals (Long Tons)	Total (Long Tons)	As Metal (Long Tons)	Chemicals (Long Tons)	Total Long Tons	Total Value
1924-28 (average)	920	1,901	2,821	7,571	22,491	30,062	$38,143,900
1929	763	2,402	3,165	6,607	24,018	30,625	30,513,300
1930	1,032	2,310	3,342	5,000	18,393	23,393	16,228,300
1931	985	1,912	2,897	4,911	12,768	17,679	9,428,800
1932	628	1,579	2,207	4,152	9,018	13,170	6,248,100
1933	838	1,792	2,630	6,473	13,259	19,732	16,508,700

(a) Figures compiled by J. P. Dunlop of the Bureau of Mines.

Virgin Tin Consumed in the United States, 1927, 1928, and 1930, by Uses

United States Bureau of Mines, Minerals Yearbook, 1934

	1927		1928		1930	
Use	Long Tons	Per Cent of Total	Long Tons	Per Cent of Total	Long Tons	Per Cent of Total
Tin plate and terne plate	24,525	35.96	27,053	36.38	27,753	42.40
Solder	13,602	19.94	13,874	18.66	11,407	17.43
Babbitt	7,595	11.14	8,150	10.96	5,438	8.31
Bronze	4,664	6.84	4,324	5.81	3,499	5.35
Foil	4,193	6.15	5,068	6.81	3,061	4.68
Collapsible tubes	2,710	3.97	2,864	3.85	(a) 3,826	5.84
Chemicals	2,621	3.84	4,246	5.71	3,268	4.99
Tin oxide	1,311	1.92	1,183	1.59	666	1.02
Tinning (brass, copper tubes, sheets, shells, wire, nails, etc.)	2,661	3.90	2,636	3.54	2,814	4.30
White metal	849	1.25	802	1.08	1,117	1.71
Type metal	450	0.66	411	0.55	223	0.34
Castings	1,011	1.48	730	0.98	(b) 74	0.11
Other alloys	556	0.82	629	0.85	306	0.47
Miscellaneous	1,450	2.13	2,399	3.23	1,996	3.05
	68,198	100.00	74,369	100.00	65,448	100.00

(a) Not comparable with preceding years owing to the canvassing of several additional users whose consumption was not included previously.
(b) Pure tin castings only; in preceding years some tin-alloy castings were reported under this heading.

The Right Answer

When the real solution of the tin problem is reached it will be had by the combination of several of the plans suggested in the foregoing and perhaps with even other entirely separate co-equal parts. But it does not take a soothsayer to forecast that in the ultimate solution, to be lasting and satisfying, equitable and workable, there will be at least the following elements:

1. Provision for thorough, impartial, competent survey of every potential domestic resource which might affect tin supply either commercially or even in an emergency.

2. A fundamental set of technologic

researches on proper utilization of tin, the development of successful substitutes for tin, and the development to commercial scale of tin recovery technology to minimize the current consumption and increase the reclaimable uses.

3. An economic survey by the Bureau of Mines with an international outlook to determine all pertinent facts and trends.

4. Legislation, in so far as this is necessary, to permit and encourage the establishment of a tin-buying Pool, with such provisions as would make financially desirable the irrevocable participation in this enterprise by every major United States user of tin.

5. Provision for governmental loans to a tin-buying Pool so that the money cost of carrying stocks of tin would be reduced as far as possible by the availability of low-interest loans.

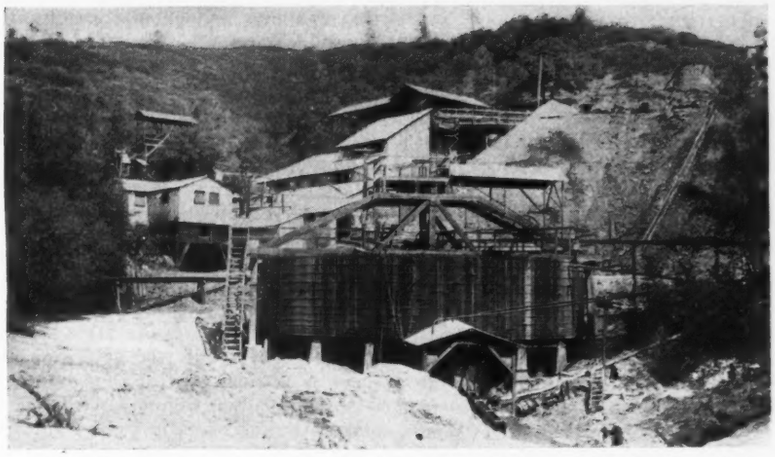
6. Embargo on export of tin scrap and secondary tin, so arranged as *not* to curtail the export of tin plate.

7. Formulation of a tin-utilization plan which would correlate industrial requirements and potential military needs with stocks, reserves, and domestic production facilities under a variety of possible emergencies. In other words, a definite Government plan by which the Government would coordinate its needs and interests with those of producers, marketers (including importers), and users of both the interruptable and the essential types.

In the consummation of a general program made up of these parts and others, there is no need to assume militaristic intention or unfriendly attitude to foreign producers, and not even any essential controversy with the tin Cartel. The proceeding, if fairly and equitably handled, should be in appearance, as well as in fact, the establishment of the plan whereby our nationals may live profitably and pleasantly in business relations with the world's producers without imposing any needless burdens on users or subjecting the United States Government or its industries to threat of foreign domination or excessive foreign price manipulation.

Conservation Imperative

Ultimately, tin reserves of the world will disappear. It will best serve the interest of producers and users if, in anticipation of that time, substitutes are developed for those purposes for which it is most convenient to use some other commodity of more abundant supply. Even the present generation in business may profit most by such a plan. Certainly, if there be not intelligent effort toward such scientific development, tin prices are likely to advance soon to a level which will compel substitution and may altogether disrupt the industry as it is now constituted.



The 250-ton mill of the Montezuma-Apex at Nashville. In the foreground is the 50-ft. Dorr thickener which serves to unwater the flotation tailings

Montezuma-Apex

Newest Mother Lode Producer

Successful reopening of two long-idle properties in California spells hope for similar ventures elsewhere—The gold is recovered by amalgamation and flotation

John B. Huttl
Assistant Editor

BESIDES having a stimulating influence on the mining industry in California by encouraging other projects for reopening idle mines, the success which accompanied the reopening of the Montezuma and Nashville properties by the Montezuma-Apex Mining Company, a subsidiary of the Utah-Apex Mining Company, proves that the Mother Lode still holds some surprises, even after nearly eighty-four years of mining. Both mines have a long and eventful history, and are situated on the east bank of the Consumnes River near the town of Nashville, about 12 miles south of Placerville, Eldorado County. Gold-bearing veins have been worked in this area from as early as 1850, chiefly by Mexican miners, and the term Mother Lode, or *Veta Madre,* is said to have originated in this section of the Mother Lode belt.

The Montezuma and Nashville mines have been operated under separate ownership at different times since the discovery of gold and up to the beginning of the present century, the last productive year being 1906. According to State records, a water-driven ten-stamp mill was in operation at the Montezuma and a twenty-stamp mill, driven by steam power, was constructed at the Nashville, also known as the Havilah or Hendy mine, in the early 'nineties. Both properties were acquired and reopened by the present owners in the early part of 1933, and together with adjoining claims comprise about 150 acres of mineral land.

The mines are developed by inclined shafts following the vein structure in a general way, and having an inclination of from 60 to 70 deg. from the horizontal. At the time of the shutdown in 1906, the Nashville shaft had reached the 1,050 level, whereas the Montezuma shaft was stopped at the 900 level. Since the reopening of the mines in 1933, the Montezuma shaft has been deepened to 1,300 ft. (vertical depth), and levels have been opened up at 300, 400, 550, 700, 900, 1,100, 1,200 and 1,300 ft. Sinking is still in progress. The workings of the two mines are now connected on the 1,050 and on the 1,200 levels.

As to surface plants, the company has spared no efforts to obtain reliable service and economies in operation. The hoisting equipment consists of two motor-driven single-drum hoists, operating 2-ton self-dumping skips, with a capacity of about 250 tons of ore a day. Air for underground and surface operations is obtained from the central plant at the Montezuma mine, at which point also are the 250-ton mill, repair shops and storeroom, change house, timber-framing shed, and an office building. The surface plant at the Nashville mine comprises a hoist house and a wooden headframe with a built-in storage and loading bin.

Underground, drilling is done with IR L74 drifters, C-P and Cochise stopers, and Cochise jackhammers. Detachable IR Jackbits are used in place of the conventional hollow drill steel. All tramming is done by hand in 1-ton end-dump cars. Timber consumption is moderate.

The country rock is Mariposa slate with occasional small inclusions of greenstone, in which are found irregular lenses of quartz ranging from a few inches to 20 ft. in width. The main vein structure has a strike slightly east of north and a steep dip to the east. Ore values, which are in the form of metallic gold and gold associated with sulphides of iron together with small amounts of antimony, bismuth, lead, and copper, occur in pockets and lenses in the quartz. The values contained range from a few cents to several hundred dollars per ton. In mining the orebodies a selection of values is possible to a certain degree, but the best results are obtained by extraction without regard to minor variations in value. In consequence, the average grade of ore sent to the mill assays between 0.20 oz. and 0.30 oz. in gold per ton. The mining method found to be best adapted to the orebodies and ground conditions is square-set and fill. Production of the Montezuma and Nashville mines is 230 tons a day at present. The total cost of mining, development and milling is $4 per ton.

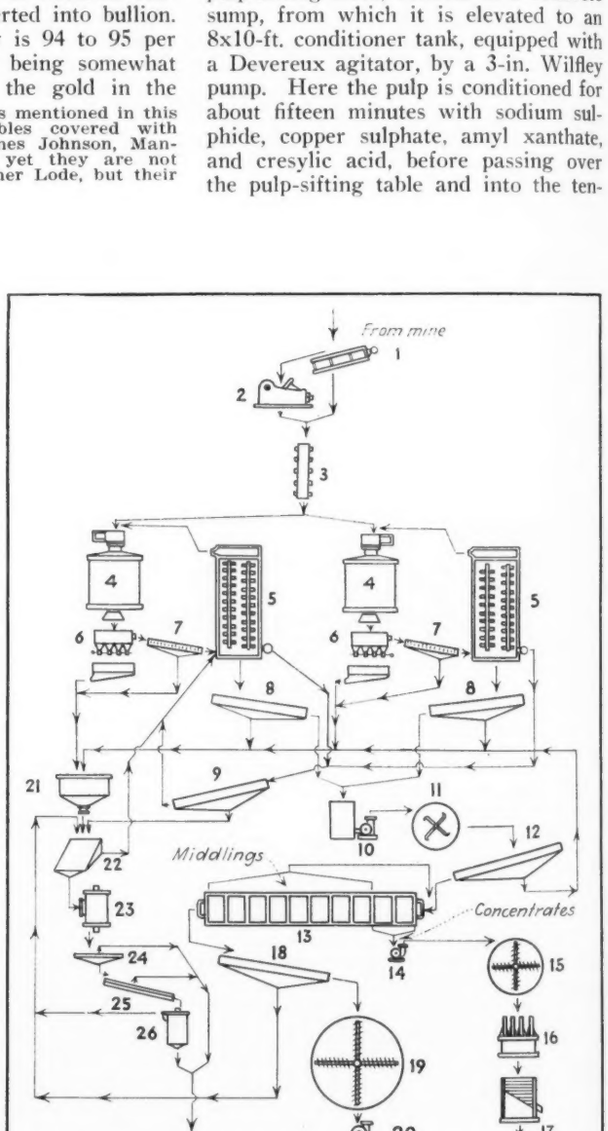
Operations at the 250-ton mill are interesting. With the exception of minor deviations such as the use of hydraulic traps between the ball mill and classifier in place of the conventional unit cell, jigs, or riffled flumes, and the application of stationary pulp-sifting tables[1] before and after flotation for the recovery of free gold, the flowsheet as given in the accompanying cut is similar to that of the newer flotation plants built recently in California. Addition of pulp-sifting tables to the mill flowsheet has improved monetary recovery materially in that a part of the gold, which ordinarily would be recovered in the form of flotation concentrate, can be converted into bullion. Metallurgical recovery is 94 to 95 per cent, the exact figure being somewhat uncertain because of the gold in the circuit which is not accounted for until a final clean-up is made. The tailings loss is 5 to 6 per cent. Of the values won, about 74 per cent is bullion and 26 per cent in the form of concentrates.

At the crushing plant the ore is passed over a Robins vibrating screen, from which the undersize is conveyed by belt to the mill bin and the oversize fed to a Blake jaw crusher set to produce a 1½-in. product. This is followed by grinding to flotation size, about 65 mesh, in two 64½-in. Marcy ball mills operating in closed circuit with Dorr duplex classifiers. Free gold is taken out of the grinding circuit by hydraulic traps and short riffled launders interposed, between the ball mills and the classifiers. The classifier sands return to the ball mills, and the overflow, after passing over two stationary tables covered with about 30 sq.ft. of pulp-sifting cloth, collects in a concrete sump, from which it is elevated to an 8x10-ft. conditioner tank, equipped with a Devereux agitator, by a 3-in. Wilfley pump. Here the pulp is conditioned for about fifteen minutes with sodium sulphide, copper sulphate, amyl xanthate, and cresylic acid, before passing over the pulp-sifting table and into the ten-

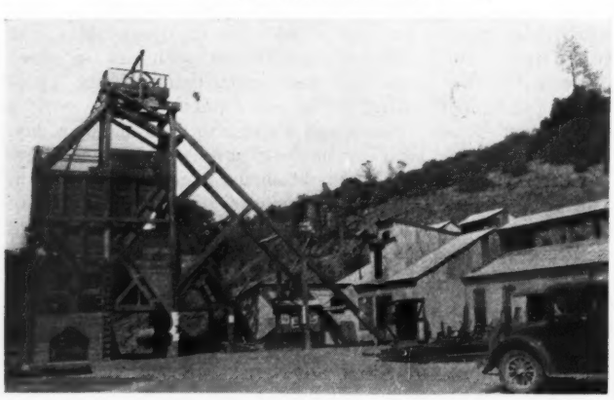
[1]The pulp-sifting tables mentioned in this article are inclined tables covered with corduroy (made by James Johnson, Manchester, England). As yet they are not widely used on the Mother Lode, but their use is growing.

FLOWSHEET OF MONTEZUMA MILL. Features include the hydraulic traps, the riffle flumes and the stationary pulp-sifting tables

1. Robins vibrating screen
2. Blake jaw crusher
3. Belt conveyor
4. No. 64½ Marcy ball mills
5. Dorr duplex classifiers
6. Hydraulic traps
7. Riffled launders
8. Pulp-sifting cloths, 30 sq.ft.
9. Periodic clean-up classifier free gold pulp-sifting cloth, 30 sq.ft.
10. 3-in. Wilfley sand pump
11. Conditioner tank, 8x10 ft.
12. Pulp-sifting cloth, 240 sq.ft.
13. Ten-cell Booth-Thompson flotation unit.
14. 2-in. Wilfley sand pump
15. Dorr thickener 20 ft. diameter
16. 4-disk American filter
17. Storage bin
18. Pulp-sifting cloth 100 sq.ft.
19. Dorr thickener 50 ft. diameter
20. 3-in. Wilfley sand pump
21. Storage tank
22. Wilfley table No. 12
23. Amalgamation barrel, 2x4 ft.
24. Mechanical batea, 4 ft. diameter
25. Plate launder, 10 in. by 6 ft.
26. Mercury trap



Headframe, with built-in primary crushing plant, and hoist and compressor house at the Montezuma mine



cell Booth-Thompson flotation machine.

Concentrates, which contain from 2 to 3 oz. of gold per ton, are taken from the first two cells and pumped by a 2-in. Wilfley pump to a 20-ft. Dorr thickener. The underflow is treated in a four-disk, 4-ft. American filter discharging the dried cake into a storage bin for shipment to the smelter, and the overflow returns to the storage tank at the head of the mill. Middlings produced by the remaining eight cells are returned to the head of the flotation machine, and the tailings flow by gravity over a large pulp-sifting table[2] to a 50-ft. Dorr thickener before being pumped to the tailings pond by a 3-in. Wilfley pump. Sampling is done automatically by Geary-Jennings samplers. Reagent consumption per ton of ore treated is as follows: Sodium sulphide, 0.40 lb.; copper sulphate, 0.20 lb.; amyl xanthate, 0.15 lb.; and cresylic acid, 0.33 lb.

The products collected from the hydraulic traps and the pulp-sifting cloths are stored for further concentration followed by amalgamation, which is done in batches twice a month. A No. 12 Wilfley table is available for this work. Table concentrate is placed in a 2x4-ft. cast-iron amalgamation barrel, and the tailings return to the mill circuit. After amalgamation the barrel contents are discharged into a mechanical batea, from which a fairly clean amalgam is recovered. The residue, after passing over a short section of silvered plates covering the bottom of a narrow launder and through a mercury trap, returns to the Wilfley table.

Amalgam recovered by the batea, the plate launder, and the mercury trap is cleaned by hand and then retorted and converted into bullion. The residue is separated into three products. First, a concentrate representing a small portion of the volume, but which contains some amalgam, is returned to the amalgamation barrel for treatment in the next batch. Second, a sulphide middling containing from 10 to 15 oz. gold per ton, which is shipped as a special smelter product. Third, tailings which contain from 2 to 3 oz. gold are mixed with the flotation concentrate.

The classifiers are cleaned out thoroughly once a month, the sands being passed over a separate pulp sifting table before being returned to the mill circuit. Power for the mine and mill is obtained from the P. G. & E. Company transmission line. The company also holds under option the Church and German mines about four miles north of Nashville, but no work is in progress there at present.

Operations are under the direction of Joseph A. Norden, general manager, to whom thanks are due for permission to publish this article and for the data contained therein.

[2]This pulp-sifting table was shown in a photograph reproduced in the California Gold Number, *E. & M. J.*, November, 1934, on p. 525. It consists of four flumes laid with corduroy.

Dominion Gold

Canada maintains rapid pace in developing new projects—At least 23 additional mills expected to start this year—Approximately 100 mines will be producing by January next

John B. DeMille
Consulting Geologist
Montreal, Que.

CANADA'S per-capita rate of gold production increased from $4.39 in 1929 to $8.05 for each of the 12,000,000 inhabitants in 1934, according to preliminary estimates of the Dominion Bureau of Statistics. This compares with $7.03 in 1933. Gold output of the United States and possessions also reached a value establishing an all-time record in 1934, $5,389,700 in excess of the value of Canada's production. The per-capita rate in the United States advanced from 38c. in 1929 to 81c. in 1934 for each of the 120,000,000 inhabitants. On this basis, Canadian gold mines have maintained a notable leadership.

In spite of unprecedented activity in mining development, however, Canada dropped from second place to third or fourth in 1934, with bullion valued at $102,242,000. South Africa and the United States, if not Russia, exceeded this figure. The growth of the industry has stimulated the exploration of outlying districts, with the result that mining camps of potential importance are appearing for the first time throughout the Canadian shield, where the most extensive known area of Pre-Cambrian rocks offers promise for long-continued, constructive progress in mineral production.

More aggressive expansion probably took place in 1934 than in any other year in Canada's mining history. Only 32 new mills had been officially announced a year ago, whereas 33 were actually put into operation, and 17 more are under construction, for 1935. McWatters, in the Rouyn section in Quebec, and Pickle Crow, in northwestern Ontario, appear to be sharing the honors for highest mill heads. The former started tuning up the new mill around the middle of September last, and during October heads were reported running between $35.36 and $53.83. The mine average at the Pickle Crow, down to the third level, has been found to be an ounce of gold to the ton.

The value of gold per ounce has advanced 69 per cent in Canadian funds above that of 1932 and 21 per cent above the average price paid in 1933. The larger mines took advantage of this condition by milling ore of lower grades. Production for the first half of the year fell off 1 per cent in the quantity of gold produced. About 95,000 oz. in excess of the record for 1933 were milled in the second six months, largely due to the output of new plants.

A few weak spots in a generally optimistic mining picture were sufficient to keep government officials on the alert for irregularities. In Ontario, Teck-Hughes touched off fireworks when market weakness both preceded and followed the official announcement of a reduction of 250 tons daily in the scale of operations, due to a combina-

Table I—New Canadian Gold Producers Announced for 1935

Province	Mining Property	District	Proposed Mill Capacity
Ontario	Wendigo	Kenora	...
	McKenzie Red Lake	Patricia	125
	Pickle Crow	Patricia	125
	Tashota	Patricia	50
	Kirkland gold belt (Morris Kirkland)	East Kirkland	100
	Lebel Oro (*a*)	Long Lake	200
	Gillies Lake-Porcupine	West Porcupine	100
Quebec	Lamaque (*b*)	Bourlamaque	225
	Canadian Malartic	Fournier	150
	Arntfield	Boischatel	125
	Robb-Montbray (*c*)	Boischatel	...
Manitoba	God's Lake (*c*)	God's Lake	500
	Gunnar Gold	Big Rice Lake	...
British Columbia	Ymir Consolidated (Goodenough) (*a*)	Nelson	100
	Ymir Yankee Girl (*a*)	Nelson	100
	Sheep Creek Gold (Queen) (*d*)	Sheep Creek	100
	Meridian (*a*)	Cambrone	...
	Congress Gold	Brudge River	100
	Grandoro	Osoyoos	30
Nova Scotia	Bluenose Gold Syndicate (*a*)	Stormont	50
	Rainy River Kirkland (Kemp) (*a*)	Yarmouth	25
	Guysborough Mines (Ventures) (*a*)	Goldenville	50
	Nova Scotia Gold	Tangier	25

(*a*) Formerly in production. (*b*) Production to start in June. Mill capacity to be 450 tons. (*c*) Initial capacity 160 to 170 tons. (*d*) Previous production $1,300,000 (1909-1916). (*e*) About 4,000 tons available for milling.

Table II—Proposed Increases in Mill Tonnage at Canadian Gold Mines Producing in 1934

Province	Mining Property	Mill Average 1934	New Tonnage Capacity	Date of First Production
Ontario	Lake Shore	2,400	2,500	1918
	Hollinger	5,000	8,000	1910
	McIntyre	2,400	2,600	1912
	Dome	1,500	1,500	1910
	Coniaurum	400	500	May, 1928
	Buffalo Ankerite	390	500	June, 1926
	Vipond	300	300	1911
	Teck-Hughes	1,300	1,050	1917
	Wright-Hargreaves	945	1,000	May, 1921
	Toburn	100	100	1913
	Sylvanite	360	360	July, 1927
	Kirkland Lake Gold	200	200	1919
	McMillan	100	125	Aug., 1934
	St. Anthony	100	150	Aug., 1934
	Bidgood Consolidated (*c*)	50	100	July, 1934
	Barry-Hollinger	90	150	July, 1926
	Paymaster Consolidated	140	500	Oct., 1934
	Marbaun	140	150	1926
	North Shores (Palmer)	25	75	Sept., 1934
	Ardeen (Moss Gold)	100	200	March, 1932
	Ashley (*e*)	100	150	Aug. 1932
	Macassa	200	200	Oct., 1933
	Central Patricia	55	110	June, 1934
	J-M Consolidated	35	100	May, 1934
	Dikdik	...	...	1934
	Casey Summit	50	75	July, 1934
	Howey	1,200	1,400	April, 1930
	Little Long Lac	125	200	Sept., 1934
	Northern Empire (Newmont)	90	150	March, 1934
	Minto	75	100	June, 1931
	Young-Davidson	500	800	Sept., 1934
	Parkhill	60	100	July, 1931
	Matachewan Consolidated (Canadian Matachewan)	100	100	Nov., 1934
Quebec	Noranda (*a*)	3,000	3,000	Dec., 1927
	Sisco	345	360	Jan., 1929
	Beattie	1,338	1,400	May, 1933
	O'Brien Cadillac	100	100	Sept., 1932
	Green Stabell	60	80	Dec., 1933
	Sullivan	50	100	May, 1934
	Bussieres (Treadwell Yukon)	150	150	1932
	Granada	100	200	June, 1930
	McWatters	50	75	Sept., 1934
	Perron (Mathews)	20	100	1933
Manitoba	Hudson Bay Mining & Smelting (Flin Flon) (*a*)	4,300	4,600	Sept., 1930
	San Antonio	210	300	May, 1932
	Diana Gold	27	50	July, 1934
	Beresford Lake (Oro Grande)	75	75	July, 1932
	Central Manitoba	150	150	April, 1927
Nova Scotia	Lacey	30	30	1934
	Montague	60	80	1933
	Bacon	20	20	Nov., 1934
	Seal Harbour Gold	20	20	1934
	Queen	50	50	1934
British Columbia	Island Mount (Newmont)	50	50	Nov., 1934
	Superior (Providence)	25	50	Oct., 1934
	Grange	50	60	Oct., 1934
	Windpass	50	50	Jan., 1934
	Relief-Arlington (*h*)	50	50	1933
	Nicola (*d*)	...	100	....
	Columario (*g*)	50	75	....
	Surf Point	25	25	1934
	Vidette	40	75	Dec., 1933
	Reno	60	100	Aug., 1929
	Morning Star (*b*)	30	...	Oct., 1934
	Dunwell	25	...	May, 1934
	Minto	50	...	Dec., 1934
	Bullion (Quesnel Lake)	...	...	1934
	Bralorne	200	500	Feb., 1932
	Pioneer	300	400	1928
	Premier	400	600	1919
	Dentonia	100	100	April, 1934
	Kootenay Belle (*f*)	36	60	Dec., 1934
	Wayside	20	50	Nov., 1934
	Highland Lass	...	...	1930

(*a*) Copper-gold producer. (*b*) Shipping to custom mill. (*c*) Treating ore from Moffatt-Hall. (*d*) Intermittent operation, 1929, 1930, 1934. Now closed down. (*e*) Controlled by Mining Corporation of Canada. (*f*) Production of $83,986 prior to 1909. Again active in 1927-28. (*g*) Production temporarily suspended (*h*) Premier holds 52 per cent interest.

tion of causes. In Quebec, Thompson-Cadillac built a 150-ton mill, claiming ore reserves for two years, but not long after working at the rate of 60 to 70 tons daily the company went into voluntary receivership. When examined by an independent engineer, the mine failed to show all of the ore claimed by the company. In British Columbia, Wayside and Nicola came in for official investigation. (In the case of the former the proceedings have been temporarily stopped by court injunction.—Editor.)

On the whole, the year witnessed no event that affected the welfare of gold mining in Canada as fundamentally as the Dominion tax on bullion, which was imposed last April. In the face of federal assurance of cooperation, the new burden fell unexpectedly on the dividend-paying producers. The provincial tax on profits netted Ontario $942,000 in 1933 and $1,500,000 in 1934, and is expected to amount to $2,000,000 this year. Added to this the Dominion gold tax on Ontario's production in 1934 will amount to $3,821,000, according to official estimates.

More than 71 per cent of Canada's gold production came from Ontario in 1934. H. C. Rickaby, Provincial Geologist, estimates that output from Porcupine and Kirkland Lake advanced 17 per cent over the record for 1933 and will show a further 15 per cent increase in 1935. Teck-Hughes, however, stands out counter to the general trend by announcing in the recently issued annual report that maximum depths for profitable mining may be reached within three years, as a result of an increase in costs from $11.04 to $15.04 per ounce.

Three new mines reached the production stage in northwestern Ontario for the first time, and eight others in various parts of the province also started milling. Exploratory work carried on by Hollinger in Hislop Township has shown important possibilities for future production. The Little Long Lac district continued as the scene of intensive investigation, and just to the west, in the Sturgeon River area, a gold rush reached major proportions. Official announcements have been made by seven mining companies, and others are approaching the milling stage. Algoma Summit (McCarthy-Webb) represents a group with plans for small-scale production in 1935.

In Quebec, ranking next to Ontario in gold output, new producers in 1935 may include Sigma, being developed by Dome Mines, and the Powell Rouyn, Thompson-Joannes, Tiblement Island, and Shawkey. The Arntfield had intended mill construction last year, but under a new policy the first unit of a large-scale project is to be built immediately. Canadian Pandora has been slowed up by financial trouble, with limited prospects as to milling plans for the time being.

British Columbia's mineral production in 1934 is expected to show a 28 per cent increase over that of the year previous. Over a twenty-year period, the 1934 output represents a normal average and is a great increase from the 1932 low point. On the basis of quantity, 1934 figures show mineral production which approaches the 1929 record high. Many of the gold properties which formerly were in active operation are being revived and at least five have reported plans for milling in 1935. The Hedley district has been under intensive investigation, the famed Rossland properties are being opened up, and prospecting activity has extended from the Bridge River district north to Portland Canal.

Placer mining in the Yukon was unchanged from a year before, but efforts are being made in the district to establish lode mining.

As shown in Table I, at least 23 milling operations will be started in five provinces during 1935. By the end of the year approximately 100 gold mines will probably be contributing to Canada's output. By that time the full effects of the greater percentage increase that took place in 1934 will be felt. A conservative estimate of 1935 gold production, if present prices are maintained, would be in the neighborhood of $115,000,000.

Table III—Canadian Dividend Payers in 1934

Province	Mining Company	Location	1934 Dividend
Ontario	Lake Shore (c)	Kirkland Lake	$7,000,000.00
	Wright-Hargreaves (b) (c)	Kirkland Lake	3,025,000.00
	Teck-Hughes (d)	Kirkland Lake	2,643,929.20
	Sylvanite (b) (c)	Kirkland Lake	824,875.00
	Kirkland Lake Gold (a)	Kirkland Lake	157,173.69
	Toburn (a)	Kirkland Lake	148,000.00
	Macassa (a)	Kirkland Lake	131,399.40
	Hollinger Consolidated (c)	Porcupine	6,907,680.00
	Dome Mines (b) (c)	Porcupine	3,336,669.00
	McIntyre Porcupine (b) (c)	Porcupine	1,596,000.00
	Buffalo Ankerite (c)	Porcupine	87,341.16
	International Nickel common (e) (b)	Sudbury	7,289,084.50
	International Nickel preferred (b)	Sudbury	1,933,898.73
	Falconbridge Nickel	Sudbury	901,514.40
	Howey Gold Mines (a)	Red Lake	500,000.00
	Anglo-Huronian (f) (e)	Red Lake	501,042.00
	Nipissing (f) (e)	Red Lake	150,000.00
	Coniagas (f)	Red Lake	96,415.00
	McKinley (f)	Red Lake	28,096.55
Quebec	Noranda Mines (b) (c) (g)	Rouyn Township	4,479,544.00
	Siscoe Gold (c)	Dubuisson Township	902,500.00
Manitoba	San Antonio (a)	Central Manitoba	112,215.10
British Columbia	Consolidated Mining & Smelting (c)	Trail	2,931,637.50
	Howe Sound (f) (g)		1,066,029.75
	Pioneer Gold (c)	Sillooet	1,138,637.50
	Bralorne (a)		625,000.00
	Premier Gold	Portland Canal	625,000.00
	Highland Lass (c)		36,966.00

(a) First dividend to be paid. (b) Payment in United States funds. (c) Increase over 1933 disbursement. (d) $240,357 less than 1933 disbursement. (e) Not paid in 1933. (f) Holding company. (g) Copper-gold.

Annual dividends paid by Canadian metal mines increased from $27,922,642 in 1933 to a record total of $49,150,648 in 1934. Mining dividends in 1933 marked an increase of only $4,000,000 above the record for the preceding year, whereas in 1934 the increase amounted to more than $21,000,000. The all-time dividend total has reached $593,267,648, of which about two-thirds has been paid in the last fifteen years.

In 1933 only two mining companies were added to the list of dividend payers (Buffalo Ankerite Gold and Falconbridge Nickel). Eight new companies made their first payment to shareholders in 1934, as noted in Table III, and two others, Reno and Northern Canada Mining Corporation, made their initial payment this last January. International Nickel received returns on common shares. Nipissing's illustrious name was restored to the dividend group with an interim payment last August and Coniagas, another of the old-time Cobalt operators, maintained the 1933 rate.

The nickel mines of the Sudbury district are still responsible for an aggregate dividend disbursement exceeding all other mining districts in the Dominion, with a total to the end of last year amounting to $158,214,851.24. Next come the British Columbia mining companies, with a total of $127,831,972.10. The silver producers of the Cobalt district ranked third until last year, but now the Porcupine gold producers have built up a higher figure, $111,994,344.35, compared with $105,789,067.47, Cobalt's total dividends to the end of 1934.

Seven of the Kirkland Lake mines combined to distribute more in 1934 dividends than any other Canadian mining district and brought the total to date to $69,182,633.89. For the last three years dividends from Quebec mining companies have exceeded British Columbia's record, and since 1930 the Quebec total amounts to $19,066,497.71. Not included in these figures is the additional amount in exchange paid by six companies whose dividends are or were in United States funds.

Cost of Producing an Ounce of Gold

A Graph to Facilitate Comparisons

C. N. Schuette
Consulting Engineer
San Francisco

THE INCREASED PRICE of gold, now at $35 per fine ounce, has stimulated interest in all properties formerly worked for this metal. Besides the incentive of price, the comparatively recent and often highly successful application of the flotation process in the treatment of gold ores is responsible for much of the new activity.

In California and Nevada many of the new operations on gold mines beneficiate the ore in flotation plants and truck their concentrates to the smelter for treatment. In a number of such plants that have come under my observation the recovery is approximately 90 per cent and the net smelter return is about $32 per ounce of gold in the feed assay.

The accompanying graph was prepared for rapidly comparing such operations and their possibilities of yielding a profit. The grade of the ore is shown in both ounces and dollars per ton as the ordinate, and the cost in dollars per ounce of gold produced is shown as the abscissa of the graph. The curves represent the total cost of operation expressed in dollars per ton.

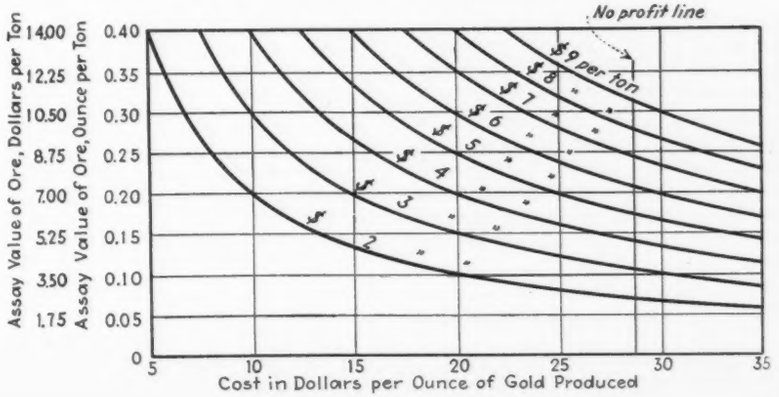
On the basis of a 90 per cent recovery and a $32 smelter return, the net return of the operation is $28.80 per ounce of feed, and this figure is shown as the "no-profit" line on the graph.

The use of the graph is best illustrated by an example. Say that 0.25 oz. ore is being treated at the rate of 100 tons per day and a total cost of $5 per ton. Then from the graph, 0.25 oz. ore treated at a cost of $5 per ton gives a cost (on the abscissa) of $20 per ounce of gold produced. Profit per ounce then is $28.80 —$20.00 = $8.80 per ounce. At a milling rate of 100 tons per day of 0.25-oz. ore the daily gold production will be 25 oz., and this times $8.80 equals a profit of $220 per day.

The lower limit of ore that can be treated at a profit can be quickly ascertained by using the graph. For example, the lower limit of profitable ore that can be treated at a cost of $5 per ton is the ordinate reading at the point where the $5 per ton curve intersects the "no-profit" line, and this is seen to be ore assaying 0.175 oz., or $6.13, per ton.

Thus the graph aids in determining quickly possible operating profits on the basis of the usual estimates of grade of ore and total cost of operation in dollars per ton.

Graph for determining the cost of an ounce of gold as related to grade of ore and mining and milling cost. The "no-profit" line is at $28.80, based on 90 per cent mill recovery and $32 per ounce smelter return



Mine Roof and Support Design

As Applied to Flat-Lying Beds Stressed Within Elastic Limits

P. B. Bucky
Assistant Professor of Mining,

A. J. Toering
Research Assistant in Mining

School of Mines, Columbia University, New York, N. Y.

EVIDENCE that the known laws of mechanics may be applied to the solution of problems pertaining to mining structures stressed within the elastic limits was presented in a previous paper[1]. This field is as yet new to the mining engineer, and realization that a large amount of scientific data has been collected and procedure developed should augur well for rapid progress. Possibilities for the application of these laws are so numerous, and some of them of such complexity, that limitation of the material in this paper to the solution of span and support problems for structures in flat-lying beds seems desirable. The cases to be presented may be listed as follows:

Case I.—A structure in which the mine roof extends to the surface.

Case II—A structure in which the mine roof is overlain by material that does not load it.

Case III—A structure in which the mine roof is overlain by material that does load it.

Case I—The first case is illustrated by Fig. 1. This is a section through an orebody mined by the room-and-pillar or stope-and-pillar system. Distance y is assumed to be great, and the problem is to determine the room or stope span, L, and the pillar width, P_w, for economical and safe mining. The mine structure is to be designed with a safety factor of 5. One should note that the roof forms a continuous beam fixed at both ends. The assumption is made that geological information was obtained from boreholes with diamond or shot drills. The cores were used as samples for both model and strength tests. Sinking of the shaft provided much material for testing and served as an additional check on the geology as deduced from the borehole data. These data showed a 20-ft. sandstone roof underlain by a 5-ft. orebody, which was underlain, in turn, by at least 20-ft. of bottom rock. The results of laboratory tests on the roof, orebody, and underlying rock were assumed to be determined in the regular manner and as shown in the accompanying table.

[1]"Mechanics and Mining," *Engineering and Mining Journal*, Feb., 1935, by P. B. Bucky and A. J. Toering.

Structural Characteristics of the Materials Composing the Structure

	Roof	Orebody	Bottom
Weight per cubic foot, lb.	150	100	200
Utlimate compressive strength, lb., per sq. in.	5,000	1,000	10,000
Ultimate shear strength, lb. per sq. in.	1,000	1,000	2,000
Ultimate tensile strength, lb. per sq. in.	200	100	300
Modulus of elasticity	1,000,000	1,000,000	1,000,000

In this paper the weight per cubic foot of material is represented by the symbol K, and the modulus of elasticity by the symbol E.

One may find that the structural characteristics of the geologic materials composing the mining property vary considerably. If this condition exists, judgment must be exercised in the assumption of a safety factor and design values. In general, the lowest test values, modified by the use of a safety factor, should be used in design. For example, if tests show that the ultimate tensile strength of the roof rock in the area under consideration varied between 200 and 400 lb. per square inch, and a safety factor of 5 is specified, then the allowable unit stress in tension would be 200 divided by 5, or 40 lb. per square inch, or 5,760 lb. per square foot. This figure should be checked against the information on the stress deformation curve to make certain that it lies within the elastic limits for this material.

Determining Safe Span

The safe span is determinable from the following formula:

$$(1) \qquad L = \sqrt{\frac{2BD^2S}{w}}$$

where L = safe span in feet
B = breadth of roof beam in feet = 1
D = depth of roof beam in feet = 20
S = allowable unit tensile stress, in pounds per square foot = $\frac{200 \times 144}{5} = 5{,}760$
w = weight per lineal foot of roof, in pounds = $20 \times 1 \times 150 = 3{,}000$

Therefore,

$$L = \sqrt{\frac{2 \times 1 \times 20^2 \times 5{,}760}{3{,}000}} = 39.2$$

This means that the allowable distance between pillar center lines is 39.2 ft.

Determination of Pillar Size

The width of pillar for these conditions may be obtained from the following formula:

$$(2) \qquad P_w = \frac{P_l}{P_s}$$

where P_w = pillar width in feet
P_s = allowable unit stress in pillar in pounds per square foot
P_l = load per running foot of pillar in pounds

The data in the accompanying table give the crushing strength of the pillar material (ore) as 1,000 lb. per square inch, or 144,000 lb. per square foot. With a safety factor of 5, the allowable unit stress per square foot (P_s)=144,000 divided by 5, or 28,800 lb.

P_l the load per running foot of pillar= $KBDL$, the values of which have been given. P_l=150×1×20×39.2=117,600 lb. P_w is therefore equal to $\frac{117{,}600}{28{,}800}$, or 4.1 ft.

The pillar must now be investigated for its slenderness ratio[2], expressed by:

$$(3) \quad \frac{H}{R}$$

where H=height of pillar
R=least radius of gyration

For this case the slenderness ratio is $\frac{5}{2.05}$. The preceding means that the workings may now be designed with open spans of 39.2 minus 4.1, or 35.1 ft., and pillars 4.1 ft. wide, the distance between

[2]Generally referred to as $\frac{L}{R}$ or slenderness ratio in texts. For steel columns $\frac{L}{R}$ ratios of 100 are allowed. In mining this ratio can be much lower.

the pillar center lines being 39.2 ft.

The theory of mechanics deals with line supports. Calculations that determined the span to be 39.2 ft. assumed the support (pillar) to be a knife edge. The width of pillar required, however, owing to its compressive strength, is 4.1 ft. This results in a reduction of the working span to 35.1 ft. A further assumption is that the load on the pillar distributes itself evenly over its entire cross-section. This is not strictly true, as is evidenced by pillar spalling. (A series of investigations to determine the stress distribution in pillars—that is, over wide supports—is being undertaken.) This paper will assume line supports and loads equally distributed over the pillar within the elastic limits.

Span and pillar dimensions are now such that the mine roof and pillars are capable of withstanding the tensile and compressive stresses induced in them. One must now determine the roof's ability to withstand the bearing stresses induced by the pillars and roof. These investigations are routine procedures to one acquainted with the strength of materials. For the sake of brevity the assumption will be made that the reader is capable of investigating the roof and bottom from these standpoints and that the present structure satisfies these conditions.

Artificial Roof Support in Stopes

Since the mine roof is a continuous beam it will behave as such and sag or deflect. This is illustrated by Fig. 2, which shows the sag in a roof stressed within the elastic limits. It is evidenced by the deformation of the props. With support at the pillars only, the amount of sag at the center may be calculated from the following formula:

$$\delta = \frac{12wL^4}{384EI} \qquad (4)$$

where

δ = deflection in inches
w = weight per lineal foot of span (3,000)
L = open span in feet (35.1)
E = modulus of elasticity = 1,000,000
I = moment of inertia = BD^3 divided by $12 = 1 \times 20^3$ divided by 12.

On substituting these values, the amount of the deflection at the center is found to be 0.21 in. If timber is put in after the roof has assumed its full deflection, the amount of load on the timber will depend only on the force with which the timber wedges are driven. If, however, timber is placed before the roof assumes its deflection, then the timbers will carry the load.

One may now determine the timber dimensions assuming that they are placed at 5-ft. intervals along the stope or room center line before roof deflection takes place. Referring to Fig. 1, one may note that the load per timber equals $\frac{5wL}{2}$; L in this instance is 35.1 ft. and the load per timber $= \frac{5 \times 3{,}000 \times 35.1}{2} = 263{,}250$ lb. If the allowable working stress of the timber is taken as 1,300 lb. per square inch, then round timbers 203 sq. in. cross-section, or 16 in. in diameter, are required.

The placing of this timber to prevent elastic deflection at the center will relieve the load on the pillar. The load per running foot of pillar now is $3{,}000 \times 21.6$ or 64,800 lb., whereas before the placing of the center props it was 117,600 lb.

The following facts may therefore be noted as based on the application of the laws of mechanics for these conditions:

1. A line of timbers down the room center is not necessary.

2. If timbers are placed to prevent deflection at the stope or room center they must be at least 16 in. in diameter.

3. A line of timbers under 16 in. in diameter placed at 5-ft. intervals along the center line will fail unless brushed at one end so that very little load is required to reduce their heights.

4. A stope with badly deformed props and the roof not cracked is evidence that these props were unnecessary, for the load sustained by such a prop is negligible.

5. The local bearing and shear stresses of timbers on a thin, weak roof tend to do the roof more harm than good.

6. The placing of timber before the roof deflects reduces the load on the pillars.

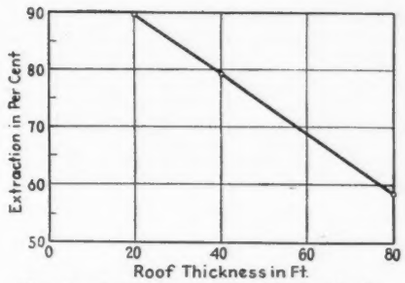
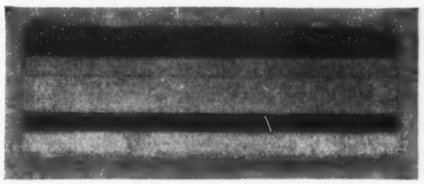


Fig. 3—Curve showing relationship between percentage extraction and roof thickness.

Mine roof extends to the surface; open span is a maximum; pillar support is a minimum; structure is stressed within elastic limits



No roof deflection; pillars vertical

Roof deflection as evidenced by pillar deformation

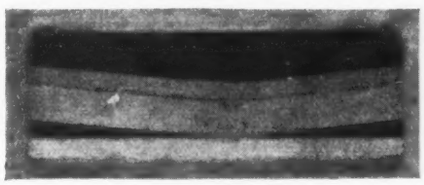


Fig. 2—Behavior of mine roof stressed within elastic limits:

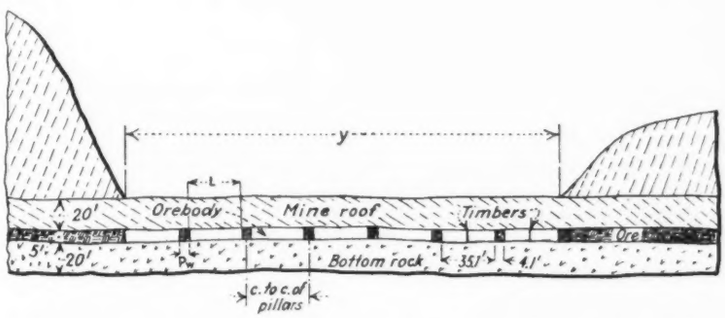


Fig. 1—Cross-section of orebody with mine roof extending to the surface

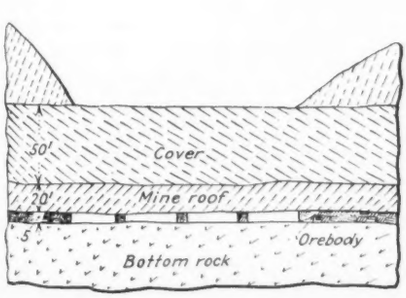


Fig. 4—Cross-section of orebody with mine roof overlain by non-loading cover

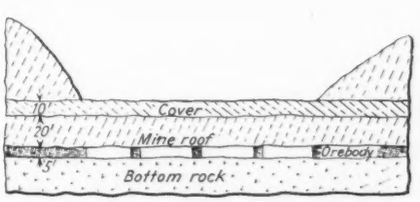


Fig. 6—Cross-section of orebody with mine room overlain by loading cover

7. The placing of timbers after the roof has assumed its maximum deflection affects the pillar load very little unless the roof is wedged up.

Effect of Roof Thickness on the Span Over Which a Solid Roof Will Support Itself

If in formula (1) one substitutes for w (weight per lineal foot of beam) the value KBD where K is the weight per cubic foot of beam material, B, beam breadth, and D beam depth, one obtains the formula:

$$(5) \qquad L = \sqrt{\frac{2DS}{K}}$$

From this formula one can see that the span over which a solid roof will support itself varies as the square root of the roof thickness or depth ($\sqrt{D}$), provided the roof is solid and as shown in Fig. 1. This is true since 2, S, and K are constants.

For example, if a roof 20 ft. thick supports itself over a 39.2-ft. span, the span that a 40-ft. roof will support itself over $= 39.2 \times \sqrt{\frac{40}{20}}$ ft., or a 55.4-ft. span.

The pillar width for these conditions as determined from formula (2) ($P_w = \frac{P_1}{P_s}$) $= \frac{150 \times 1 \times 40 \times 55.4}{28{,}800}$, or 11.50 ft., and the open span that may be worked is 55.4 minus 11.5 ft., or 43.9 ft.

If the roof is 80 ft. thick, the distance between pillar center lines is from (5) equal to $39.2 \sqrt{\frac{80}{20}}$, or 78.4 ft., and the pillar width P_w, from (2), equals $\frac{150 \times 1 \times 80 \times 78.4}{28{,}800} = 32.7$ ft.

The open span that can be worked equals 78.4 minus 32.7=45.7 ft. provided pillars 32.7 ft. wide are used.

Percentage Extraction

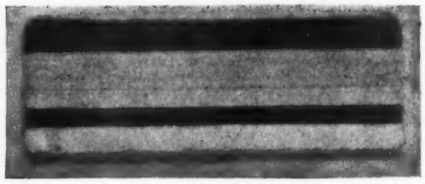
For a stope-and-pillar system the percentage extraction may be obtained by the formula:

$$(6) \qquad P_e = \frac{L_o \times 100}{L_o + P_w}$$

where P_e=percentage extraction
P_w=pillar width
L_o=open span

The percentage extraction for the 20-ft. roof therefore equals $\frac{35.1}{35.1+4.1} \times 100$, or 89.6 per cent; for the 40-ft. roof the percentage extraction equals $\frac{43.9 \times 100}{43.9+11.5}$ or 79.2 per cent; for the 80-ft. roof the percentage extraction equals $\frac{45.7}{45.7+32.7} \times 100$, or 58.3 per cent.

A comparison of these values shows that the percentage extraction decreases as the roof thickness increases.



Roof and cover

Roof deflects but cover deflects very little

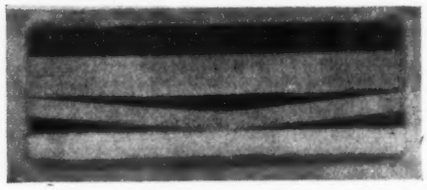


Fig. 5—Behavior of mine roof with non-loading cover:

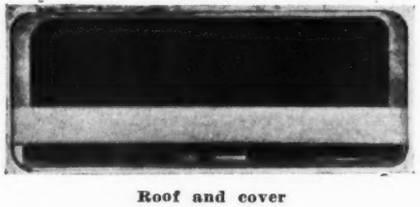
Fig. 3 is a curve showing the relationship between percentage extraction and roof thickness for a maximum working span.

Effects of Decreasing Open Span

For a structure with a 40-ft. roof the maximum distance between center lines was determined to be 55.4 ft., the pillar width 11.5 ft., the maximum open span 43.9 ft., and the percentage extraction 79.2 per cent. If one now assumes that the mine is to be laid out with a distance of $\left(\frac{55.4}{2}\right)$ 27.7 ft. between pillar center lines, then from (2) the pillar size required equals $\frac{150 \times 1 \times 40 \times 27.7}{28{,}800}$, or 5.75 ft., and the maximum open span would be 27.7 minus 5.75, or 21.95 ft. The percentage extraction for these conditions from (6) would be equal to $\frac{21.95 \times 100}{21.95+5.75}$, or 79.2 per cent.

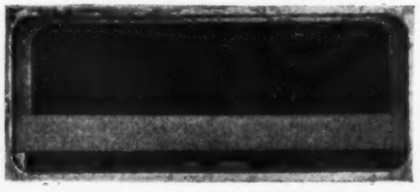
The following statements may therefore be made concerning the effect of reduction in the distance between pillar center lines:

Fig. 7—Behavior of mine roof with loading cover



Roof and cover

Roof and cover deflect



1. The strength of the mine roof is increased and its deflection is lessened because the open span has been reduced.

2. The pillars have the same load per unit area, but the $\frac{H}{R}$ ratio has been increased. If still within the limits of safe design, this has no effect.

3. The percentage extraction has not been affected.

For every property of this type the foregoing shows that a range of span and pillar dimensions exists from which a choice may be made to suit particular conditions, equipment, and methods.

Overlying Material That Does Not Load the Mine Roof— Restraint Over Pillars Poor

Case II—Assume that in another section of the property the conditions are as shown in Fig. 4. Here the 20-ft. sandstone roof is overlain by a 50-ft. layer of the same sandstone, which will be referred to as the cover. No bond exists between the two layers. The open span that can be worked with a 50-ft. layer of sandstone is obtained from the following formulas:

$$(1) \quad L = \sqrt{\frac{2BD^2S}{w}} = \sqrt{\frac{2 \times 1 \times 50^2 \times 5{,}760}{7{,}500}} = 62.0 \text{ ft.}$$

From formula (4) L varies as the square root of D; it is equal to $39.2 \times \sqrt{\frac{50}{20}}$, or 62 ft.

Previous calculations determined that the distance between pillar center lines shall be 39.2 ft. for a 20-ft. sandstone roof. Therefore the assumption will be made that the allowable span is determined by the 20-ft. roof.

Pillar Dimensions

The load on the pillars is now due to 20 ft. of sandstone roof plus 50. ft of sandstone cover, which means that a larger pillar is necessary. The load per running foot of pillar is now equal to $39.2 \times 70 \times 150$ lb., or 411,600 lb., and the width of pillar required equals 411,600 divided by 28,800, or 14.3 ft. Therefore the open span that can be worked under these conditions is equal to 39.2 minus 14.3, or 24.9 ft. One may emphasize here that, as the load on the pillar is increased, the open span that can be worked is decreased only because the pillar size must be made greater to withstand the load.

Deflections

Fig. 5 shows the roof deflections for a case similar to the one discussed. One may note that the mine roof has drawn away from the overlying material, and

therefore the overlying material loads no part of the mine roof except that directly over the pillar. The immediate mine roof in this case is ordinarily referred to as the underweight and the overlying material as the overweight. If the span were increased to more than 39.2 ft., artificial support of the underweight would be required. The sag or deflection of the mine roof for this case is obtained by substituting in the formula (4), as follows:

$$\delta = \frac{wL^4 \times 12}{384\,EI} = \frac{3{,}000 \times 24.9^4 \times 12}{384\,EI}$$
$$= 0.05 \text{ in.}$$

The sag or deflection of the 50-ft. sandstone cover=0.008 in. These values are further evidence that under these conditions the overlying materials will not load the mine roof.

Artificial Support

The amount of artificial support for no center deflections, assuming props placed at 5-ft. intervals, may be obtained as follows: The load per prop equals

$$\frac{5 \times 24.9 \times 70 \times 150}{2} = 653{,}625 \text{ lb.,}$$

allowing 1,300 lb. per square inch for prop load. The prop area required equals

$$\frac{653{,}625}{1{,}300}, \text{ or } 503 \text{ in.,}$$

or props about 25 in. in diameter. Previous discussion of the props required is also true for this case and need not be repeated. The load per prop in this case is much higher because the additional 50 ft. of cover must be supported.

Overlying Material Does Not Load Mine Roof— Restraint Over Pillars Perfect

Case II-A—If the cover is considered as restraining the mine roof over the pillar, and perfect restraint is obtained, then the mine roof between two pillars may be considered as a perfectly restrained beam, and the maximum allowable open span for a 20-ft. roof is for these conditions equal to 39.2 ft. This condition may be assumed to exist if the cover thickness is 100 ft. The pillar width may then be determined from the following relationship:

$$(2)\quad P_w = \frac{P_1}{P_2} = \frac{150 \times 120 \times (39.2 + P_w)}{28{,}800}$$

From which P_w=65.3 ft.

From these conditions the mine would be laid out with stope spans of 39.2 ft. and pillar widths of 65.3 ft.

The percentage extraction would, from (6), be equal to:

$$\frac{39.2 \times 100}{65.3 + 39.2} \text{ or } 37.6 \text{ per cent}$$

Effect of Bond Between Layers

The purpose at this time is not to discuss completely the effect of bond between layers. The cases discussed assumed no bond. A reasonable assumption is that if the bond strength between the 20-ft. roof and 50-ft. cover of Case II or II-A were considered equal to or greater than that of the material itself, then the roof thickness or depth could be assumed as equal to 70 ft., and the span and pillar dimensions determined on that basis. If the bond strength were less than that of the material, it would exert a supporting effect on the roof similar to that exerted by props.

Overlying Material Loads the Mine Roof

Case III—Fig. 6 illustrates this condition. The 20-ft. sandstone roof is loaded by 10 ft. of standstone cover, and no bond is present.

Fig. 7 illustrates what happens in the field. The sandstone roof and cover come down together. For purposes of calculation it may be assumed that one has a 20-ft. sandstone roof, but the load has been increased.

The formula (1), $L = \sqrt{\frac{2BD^2S}{w}}$, still holds, but w has now been increased from 3,000 to 4,500 lb. per lineal foot. On substituting in formula (1) one finds that

$$L = \sqrt{\frac{2 \times 1 \times 20^2 \times 5{,}760}{4{,}500}} = 32.0 \text{ ft.}$$

The pillar width is obtained from formula (2), $P_w = \frac{P_1}{P_2}$, or $P_w = \frac{32 \times 4{,}500}{28{,}800} = 5$ ft.

The open span that may be used is therefore 32 minus 5, or 27 ft., provided 5-ft. pillars are used.

The prop dimensions for any desired spacing may now be calculated, although for the calculated span and pillar width no artificial support is necessary.

If a bond of sufficient strength were present between roof and cover, the roof could be considered as of a 30-ft. thickness, and a greater span and pillar size would result. With no bond present, the 10-ft. sandstone cover loads the mine roof.

General

The same material has been chosen for the overlying and roof material to facilitate calculations. If limestone or granite overlaid or underlaid each other, then the question of their loading would be determined by their relative thickness and moduli of elasticity. The condition is often met with in coal mining where the immediate roof may consist of small bands of fine clay, coal, and shale. The problem for these cases is more complex but solvable.

Bond strength between layers is of much importance. If a 20-ft. mine roof is bonded to a 50-ft. cover of the same material, the bond furnishes support for the immediate mine roof and the deflection of the mine roof will be decreased because of that effect.

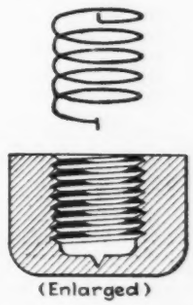
Conclusions

The general methods of determining open spans, pillar widths, and artificial supports for underground workings in flat-bedded deposits have been presented. The general laws as to the effects of increasing depths of workings on open spans and pillars and artificial supports have been indicated. Though each property presents an individual case, its problems may be approached from the standpoint of mechanics. Possibilities prevail in this field for increasing safety, lowering production costs, and increasing ore reserves. This field is new and marks a step forward from the traditional methods of solving underground mining problems. Fortunately, a great many of the principles and methods of testing have already been developed and are available for use.

•

Avoiding Loss of Carbide Lamp Springs

IN USING miners' carbide lamps, Charles Labbe, of Goldfield, Nev., writes to point out that one must exercise some care to avoid losing the small spring back of the flint and the flint also. To prevent the unscrewing of the small brass nut, harden the point of a file or a short strong piece of steel rod and



sharpen it to a chisel shape, and then, with a hammer, make a deep dent across the bottom of the inside surface of the brass nut, as shown in the accompanying sketch. With pliers, extend straight out and sharpen one end of the small spring, so that when it falls into the slot it will prevent the nut from turning and falling.

Selective Film Flotation On Tables Applied To Potash Ores

DOMESTIC PRODUCTION of potash has made rapid strides during the last four years, as indicated by the increase from 109,820 tons of potash-bearing material, containing 61,590 tons of K_2O, in 1929, to 331,110 tons, with 143,478 tons of K_2O, in 1933. Development of the potash deposits at Carlsbad, N. M., is mainly responsible for this increase. These deposits, which occur at about 1,000 ft. depth, consist mainly of sylvinite containing about 40 parts of sylvite (KCl) and 60 parts of halite (NaCl). By careful mining, the extraneous material does not amount to more than 2 to 3 per cent.

The chemical method usually employed in recovering potash from sylvinite requires expensive equipment and is costly in operation. Metallurgists at the United States Bureau of Mines, therefore, conceived the idea that ore-dressing methods now successfully applied to many non-metallic minerals might be adopted for the production of a potash suitable for the fertilizer industry. When preliminary studies had proved this to be possible, the investigation was extended under a cooperative agreement between the Bureau, the Potash Company of America, and the Missouri School of Mines. In the following is presented an abstract of a report of this study, Bureau of Mines Report of Investigations 3271, by Will H. Coghill, G. D. DeVaney, J. Bruce Clemmer, and S. R. B. Cooke.

Results obtained show that ore-dressing methods may be successfully used if a closed circuit of brine, saturated with the constituents of the ore, is maintained. Any one of three procedures will yield high-grade concentrates and high recoveries: Table concentration, supplemented by flotation; tabling an agglomerated feed, supplemented by flotation; and all-flotation. Plain table concentration gave a recovery of 69.8 per cent, with concentrates analyzing 82.7 per cent KCl; treating the fines by flotation the recovery was 97.3 per cent, with 84.9 per cent KCl in the concentrate. The two other methods gave higher concentrates and equally good recoveries.

The relative weights of the minerals in the concentrating medium is of primary importance in gravity concentration. A saturated brine (sp.gr.1.23) is the only medium worth considering here. Where, as here, the difference in density of the minerals to be separated is small, hydraulic classification should be the first step in tabling, as both density and grain size will have a pyramiding effect in favor of good separation. If the material is sized by screens, the tabling depends solely on the difference in densities.

Floating on Tables

Film flotation, in which oiled material is carried over the side of the concentrating table, is a comparatively new process which did not come into its own until beneficiation of non-metallics began. The process here considered is the selective filming or agglomeration of KCl in the presence of NaCl, and in this separation the forces of nature work in unison—KCl is lighter than NaCl, and by that property alone it tends to pass over the side of the table. When a water-repellent coating is superimposed on the KCl grains they film on the liquid interface, and the separation is accelerated. In a recent test, over 96 per cent of the KCl was recovered in a concentrate analyzing 95 per cent KCl, and the tailings contained only 3 per cent KCl. The reagent cost was about 80c. per ton of ore treated. Of the reagents tested, sodium and ammonium alkyl sulphates and related compounds gave best results. The crude oil was added to the brine-wetted ore. This was followed by the addition of the filming reagent in a water solution.

Agglomeration is at its best on 10- to 48-mesh material and gives promise of doubling the capacity of tables. This should help to compensate for the cost of reagents and reduce the first cost of the concentrator. Tests of finer portions of the ore gave good agglomeration. However, the agglomerated KCl has a tendency to occlude some NaCl. As more wash brine is required for the tabling of agglomerated fine material than for unagglomerated material, fine NaCl will also be washed over the side of the table, thus contaminating the concentrate.

Early in the investigation it was known that flotation might provide a satisfactory way of separating KCl and NaCl. Only slight success was obtained until the sulphated aliphatic alcohols were used. Excellent selective flotation of KCl, combined with low reagent consumption, has been effected by the use of these reagents and related compounds, particularly the derivatives of alcohols with 8 or 12 carbon atoms, now available in commercial form. These are expensive compared with ordinary flotation reagents, but only small quantities are needed. A reagent cost of about 18c. per ton of ore has been possible with reuse of the brine.

The simplicity of flotation should be stressed; it is applicable to ores of all grades, and high-grade and low-grade concentrates are readily produced. Only a small quantity of a single reagent is required, and a froth with good characteristics is obtained. The reagent is highly selective and flotation is exceptionally rapid, generally less than five minutes. To insure high recovery the ore should be ground to at least 35 mesh. Coarser ores may be treated, but with higher tailing losses. Tests on hydraulic classifier overflow from tabling tests showed that this material was readily amenable to treatment.

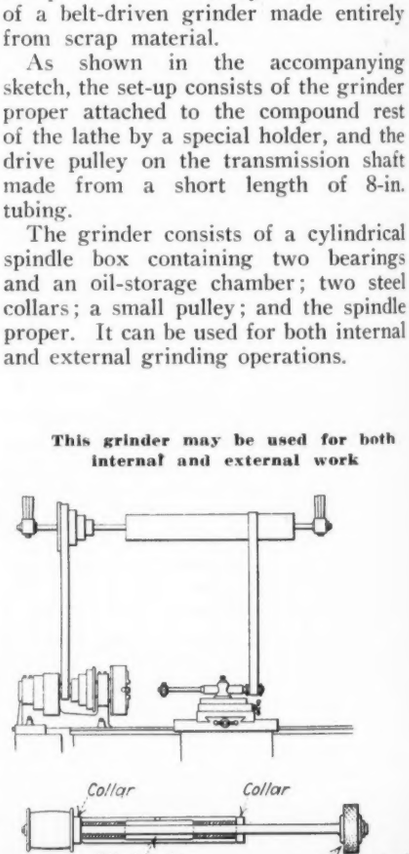
A Grinder for Case-hardened Parts

REGRINDING and adjusting case-hardened bushings, links, and bolts of conveying and excavating machinery often presents a difficult problem in shops where suitable equipment for such work is lacking. R. S. Livingston, master mechanic at Uvalde Rock Asphalt Company, Blewett, Tex., solved the problem successfully with the aid of a belt-driven grinder made entirely from scrap material.

As shown in the accompanying sketch, the set-up consists of the grinder proper attached to the compound rest of the lathe by a special holder, and the drive pulley on the transmission shaft made from a short length of 8-in. tubing.

The grinder consists of a cylindrical spindle box containing two bearings and an oil-storage chamber; two steel collars; a small pulley; and the spindle proper. It can be used for both internal and external grinding operations.

This grinder may be used for both internal and external work



Detail of spindle box and spindle

Appalachians Offer Gold Possibilities

DESPITE the fact that gold mining in the Piedmont region in North Carolina and South Carolina has been carried on for more than a hundred years, the deposits have not been exhausted. The cream of the deposits—that is, the richer and more easily accessible parts—has been skimmed, but even yet a rich stringer or pocket is found now and then at the very surface, according to a recent report (P. W. 29021) of the federal Geological Survey by J. T. Pardee. This report, consisting of 43 mimeographed pages, presents the results of an examination made by the Survey in the summer of 1934, with funds allotted by the Public Works Administration. It covered a large part of the Piedmont region in North Carolina and South Carolina, in which several hundred mines, old and new, are situated.

The mining history of the region began 130 years ago. A "boom" period from 1829 to 1836, during which the rich superficial parts of the deposits were largely mined out, was followed by a period, extending to the Civil War, characterized by deeper exploration and generally steady production. After that war mining was resumed, but it was irregular and on the average declined, and after the World War the region showed little or no mining activity worthy of note. In 1933 signs of a revival appeared, and in 1934 new development work was in progress at several of the mines.

The first recorded gold production of the United States was accredited to North Carolina during the years 1804-23 and amounted to $47,000. The total for that State to the end of 1933 was in round figures $23,550,000 and for South Carolina $5,050,000—in all $28,600,000, of which probably 90 per cent was recovered in the Piedmont region described.

In estimating the future possibilities of the region it is convenient to consider the materials underlying the gold-bearing areas by horizontal layers or zones—namely, a zone 200 ft. deep measured from the general surface, a zone next below 300 to 600 ft. thick, and below that a third zone of unknown depth.

The topmost zone includes the weathered layer called "saprolite," commonly 40 to 60 ft. thick but exceptionally 100 ft., and a layer just below in which the ores are characterized by sulphides. The great bulk of all the gold produced so far has come from these upper layers. Their orebodies have been largely mined out, but probably some ore, even in the top layer, has been overlooked. To estimate closely the proportion of these upper layers that still remain to be explored is impossible, but it may be on the order of 10 per cent.

In addition to the probable undiscovered rich stringers or pockets, the upper zone is known to contain bodies of very low-grade material that aggregate a large volume. Such bodies occur, for example, at the Black Ankle mine, in Montgomery County; the Shuford mine, in Catawba County; and the Parker mine, in Stanly County, all in North Carolina. As a rule they average less than $1 a ton (at $35 per fine ounce), and their working requires the moving of large amounts of claylike material and the separation from it of extremely small particles of gold. With the gold-bearing material of the top layer should be included a large number of mine dumps of different sizes, considerable parts of which carry from a few cents to $4 or $5 a ton.

In the intermediate zone some lodes have been thoroughly explored and others not at all. The evidence suggests that oreshoots of workable size, say 1,000 to 10,000 tons or more, remain to be found in this zone and that their average gold content may be expected to range from 0.15 to 0.50 oz. ($5.25 to $17.50) to the ton. In these bodies part of the gold is locked up in sulphide minerals, necessitating for its recovery a different treatment from that used for free-milling ores. The value of a few of these orebodies will depend more or less on their content of zinc, lead, or copper.

Evidently, in addition to oreshoots of the type described, the lodes called "mineralized zones" contain large bodies of material that ranges from 0.01 to 0.15 oz. (35c. to $4.75) to the ton. The fact that during some periods mining and reduction costs at the Haile mine were less than $2 a ton gives hope that large parts of such low-grade bodies may be successfully exploited. Owing to differences in mineralogy and other conditions, however, it is unlikely that the costs of any two deposits will be exactly the same. Therefore, comprehensive sampling and treatment tests will be necessary to determine whether any particular body is workable or not. Perhaps this admonition is trite, but it has been so commonly neglected that its repetition seems desirable. Should the low-grade bodies mentioned prove to be workable, their indicated extent is so great that they may be expected to become long-continued sources of gold in the region.

No evidence exists that present workings have generally reached the lower limits of the gold-bearing lodes. Individual orebodies have pinched out at different depths. Commonly, these bodies, whether of the richer or poorer grades, have lenslike forms, and, as is well shown in the plans of many of the mines, one lens is likely to be succeeded by another farther on. In the vertical section a similar succession is to be expected and is, in fact, shown at several of the mines. The lower limit of one body in the Gold Hill mine has not been reached at the 800-ft. level.

Removal of Small Pieces of Wood From the Mill Circuit

IN MILLS treating old mine dumps or stope filling trouble is frequently caused by pieces of wood or fuse too small or numerous to be picked by hand, writes Charles Labbe, of Goldfield, Nev. He points out that this material usually collects at the classifier overflow, and that some mills have placed a large-mesh screen at the overflow which permits the accumulated wood to be removed at intervals.

Another procedure, he adds, is to use a fixed screen of about ½-in. mesh and over that place a loose piece of ¼- to ⅜-in. mesh, with raised sides as handles for easy removal. When sufficient wood has amassed, this loose piece of screen is taken out and bumped over a piece of wood to shake off the wood, and then replaced.

When ore is handled on a larger scale and much wood and fuse are present, a worthwhile method is to place over the whole overflow a piece of screen that has the mesh lengthwise with the classifier, and then make a scraper as described in the following paragraph.

At the uprights or hangers of the classifier's rake is fastened a piece of wood, 2x2 in., or a 1-in. pipe, reaching to the end of the classifier. At the end of this piece of wood or pipe is bolted crosswise and braced a piece of old rubber belting to act as rake or scraper. Near the middle of this rake handle is a roller set on a 2x6-in. board placed across the classifier. The roller acts as fulcrum and center support; by moving it either up or down, the scraper can be made to bear more heavily or lightly.

Motion of the classifier rake up and down while it travels lengthwise moves the scraper across the screen and pushes the wood out, the scraper being lifted at the forward stroke and lowered at the back stroke.

Some Mine Concrete Costs

Per Cubic Yard, the Figure Varies According to the Class of Work

Morris J. Elsing
Consulting Engineer
Tucson, Ariz.

THE LOGICAL starting point in estimating the cost of concrete is the cost of its constituents—cement, sand, and rock. To determine this, the costs of materials for a large number of general construction jobs were averaged and found to be $4.20 per cubic yard of concrete. Most of this work was in or near industrial centers which were served by conveniently located cement plants, sand pits, and rock quarries. The average cost of materials for mine concrete was found to be about 45 per cent higher, or $6 per cubic yard of concrete. Of this amount, the cement cost $4, sand $0.70, and rock $1.30. These are approximate and in general apply to a 1:3:5 mixture.

The amount of materials per cubic yard of concrete for such a mix are as follows:

Cement, 1.22 bbl., or 459 lb., or 4.9 sacks.

Sand, 0.52 cu.yd., or 1,264 lb., or 0.63 ton.

Rock, 0.86 cu.yd., or 2,322 lb., or 1.16 tons.

To estimate the cost of the finished mine concrete in place is much more difficult than to determine the cost of the materials used. The factors which enter into the cost are exceedingly variable and include the distance from the mixing plant, the size and shape of forms, the cost of construction, their accessibility and means of filling them, the grade of the concrete, and the amount and type of reinforcing, as well as the particular underground conditions affecting the work.

In spite of the variables a rather close similarity is to be found in the costs for different classes of work. Taking a large number of costs I will try to show the average cost of solid concrete tunnel lining, guniting, and the cost of simple concrete members used in supporting underground openings.

Solid Concrete Tunnel Lining—More concrete is used in tunnel lining than in any other underground work. That employed in mines, however, is only a small part of that which goes into the tunnels of aqueducts and irrigation projects. Estimated from a large number of costs, the average cost of lining a mine tunnel or drift with 6 to 12 in. of solid concrete is approximately $10 per cubic yard of concrete segregated as follows:

Concrete Costs in Tunnel Lining

Item	Cost per Cu.Yd.
Materials	$ 6.00
Forms	1.25
Mixing and placing	1.50
Miscellaneous	1.25
	$10.00

The cost per lineal foot would, of course, depend upon the cross-section of the working and thickness of the lining.

In estimating lining costs closely, a liberal allowance should be made for overbreakage. In hard-rock tunnels the excess yardage should not amount to more than 30 to 40 per cent of the calculated lining, although it can be reduced to 15 to 20 per cent by close trimming. This, however, is done at considerable expense. An average allowance for excess concrete because of overbreakage should be about 25 per cent of the theoretical amount required.

Guniting—The process of depositing a wet mixture of sand and cement through a hose and nozzle by means of compressed air for the purpose of covering and supporting the mine workings has been in use for approximately twenty years. Used originally for sealing off mine gases, it has been found to have a much wider range of application. In certain ground, it prevents slacking and sloughing; with reinforcing it provides support to the walls and sides of underground openings; and in some timbered openings it becomes a good method of fire protection and timber preservation.

The average cost of guniting at a number of mines is found to be 4.6c. per square foot of surface covered. This is for a 1:3 mix with the gunite a half inch thick. The segregated costs of some of this work showed the following: labor, 2.1c. per square foot; cement, 1.8c.; sand, 0.5c.; and miscellaneous expense, 0.2c.

Based on actual results, an estimate of the average cost for covering mine shaft timbers with the best type of reinforcing and guniting to a thickness of one-half inch should be about 20c. per square foot.

In applying gunite a certain amount of it is lost. As gunite first strikes the rock surface some of the sand particles rebound and drop to the floor. Examination of this sand has shown it to be surprisingly free of cement. The consequence is that the first portion of the layer is rich in cement and, therefore, forms a particularly strong bond between the rock and the lining. This loss of gunite varies from 10 to 20 per cent. Theoretically, one cubic yard of gunite should cover 324 sq.ft. to a depth of one inch. Assuming a loss of 15 per cent, this area is reduced to 275 sq.ft. One yard of gunite contains approximately nine sacks of cement; therefore, one sack of cement is sufficient to cover about 30 sq.ft. of surface to a depth of one inch. With the gunite one-half inch thick the area would not be quite double, as the greatest loss occurs during the initial stages of the application.

Simple Concrete Members—In several coal mines the use of solid concrete blocks for building bulkheads has been found more economical than pouring walls of solid concrete. The average cost of such blocks is about $10.50 per cubic yard of concrete, and they are laid in walls underground at a cost of about $13.50 per cubic yard.

At a considerable number of mines reinforced-concrete timbers have been used. They generally vary in cross-sectional area from 6x8 in. to 10x10 in. The cost of a 10x10-in. post, including reinforcing, varies from 35 to 40c. per lineal foot. This is on the basis of a cost of $15 to $16 per cubic yard of concrete used and represents a cost of between 4 and 5c. per board foot of an equal volume of lumber.

Certain classes of construction require complicated forms for comparatively small amounts of concrete. No general deduction as to the cost of such work can be drawn, as each job necessarily requires an independent analysis of its cost factors. Costs for these special jobs run as high as $60 per cubic yard of concrete.

Andalusite for Refractories In the Transvaal

OCCURRENCE of andalusite in small quantities in some sands of the Zeerust and Marico districts, Western Transvaal, has been known for a long time. More recently, several sands rich in the mineral named have come to the attention of the Department of Mines at Pretoria. Investigation was begun, the tests employing heavy liquid and magnetic separation, as well as roasting and acid treatment. Mechanical and mineralogical analyses were made. The results indicate that material suitable for refractory purposes can apparently be obtained from these sands, the andalusite being confined to certain grades, the best being between ⅛-in. mesh and 40-mesh standard sieve. The samples treated are said to compare favorably with the material supplied to the Champion Porcelain Company in the United States for making spark plugs. They yield a product containing 88 to 90 per cent theoretical Al_2SiO_5, all in the form of andalusite. A report by F. C. Partridge covering the work done has been issued by the Department.

A Geologist Visits The Mohave Mining District

Scene of the discovery of the Silver Queen, major domestic gold strike of recent years

G. Austin Schroter

Mining Geologist
747 Title Insurance Bldg.,
Los Angeles, Calif.

• *Today's so-called boom is not the first for the Mohave mining district, the scene of the only major domestic gold strike of 1934, but is actually the latest of a series of booms which have occurred at intervals of approximately ten years since 1900. With the discovery of the now famous Silver Queen orebody, however, the region bids fair to come into its own.*

• *Between the periods of feverish activity and speculation, leasers alone have kept the Soledad Mountain area alive, maintaining as they have a sporadic flow of shipments of smelting ore throughout the period 1900-35.*

• *For this reason, major operators have been prone to accept Mohave as a leaser's camp, or to ignore it entirely, this in spite of its history and the splendid geological criteria everywhere in evidence.*

• *This paper is the result of a reconnaissance study only, and presents merely a sketch of the present picture. Detailed mapping will probably reveal the need for considerable modification.*

THE MOHAVE DISTRICT is situated about 6 miles south and west of the town of Mohave, in Kern County, southeastern California. It is reached after an easy three-hour drive from Los Angeles, the distance being 103 miles. Both the Southern Pacific and the Santa Fe railroad connect it with the latter.

So far as I have been able to determine, no detailed geological study of this area has ever been made. All of its production to date has been in gold and silver, the major part of which has come from three properties, the Queen Esther (silver), the Karma (silver), and the Standard group (gold).

The Desert a Detrital Sink

In its general geology the Mohave desert is a detrital sink, roughly bounded by the Sierra Nevada on the west and the basin ranges on the east. Parts of the sink represent intermontane valleys now filled with the products of erosion from the surrounding mountains. This is probably characteristic of the region. Still other parts of the desert further east are graben downdropped between majestic horsts.

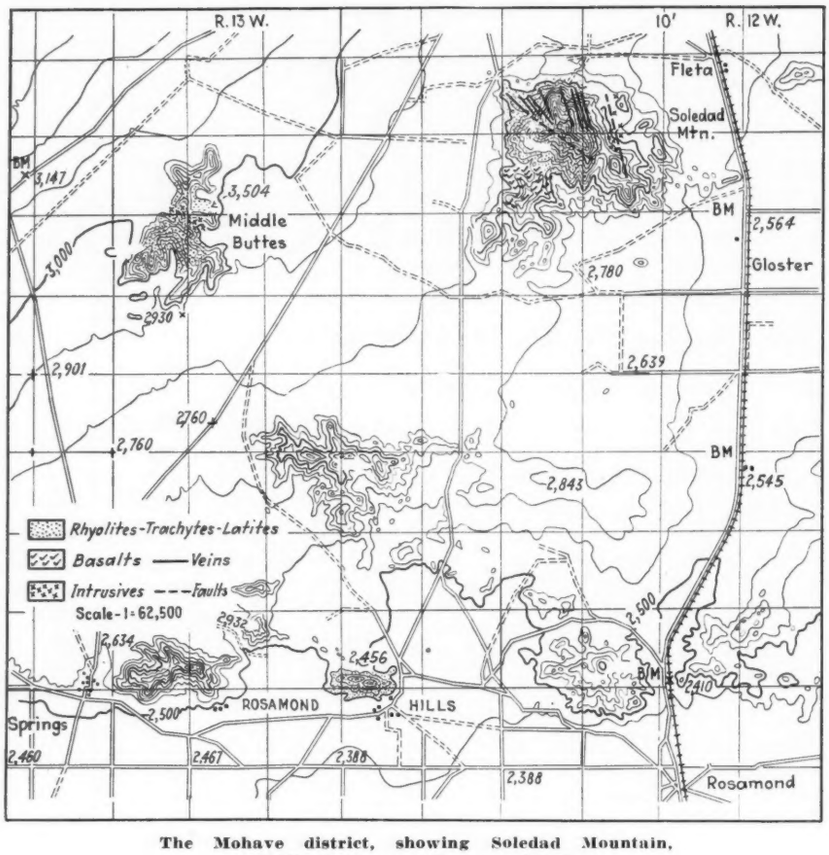
This region, one of great aridity, is remarkable for its monotony, but here and there small ranges of block mountains or isolated *insel-bergen* (island mountains) project through the sea of waste swept into the basin from the surrounding topographic highs. Soledad Mountain and its outliers, the locus of the district, are such *insel-bergen,* and represent the summits of peaks in a mountain range now practically buried in talus. The great sea of waste at this point represents the erosional products from the Tehachapi Mountains on the north, the Sierra Madras on the south, and the Coast Range on the west, all parts of a centripetal drainage system.

Intrusion, Erosion, Vulcanism, Successively

The basement rocks of Soledad Mountain are parts of a plutonic core or plug, the host rocks of which are not exposed. Where exposed, the basement is a medium-grained gray granite or quartz-monzonite porphyry, grading locally into porphyries as basic as diorites. The largest outcrops of the intrusives are near and in the Standard workings and on the extreme easterly spurs of Soledad Mountain.

In post-intrusive time, and after a long interval of erosion, there followed in Tertiary (?) time a period of great volcanic activity, during which large quantities of lavas were poured out all over this desert country. Eighteen

Soledad Mountain, in the Mohave District, Kern County, Calif. This view was taken looking south from the Yellow River claim of the Standard Group



The Mohave district, showing Soledad Mountain, Middle Buttes, and Rosamond Hills

miles east of Mohave, the age of these lavas is fixed quite definitely as post-Pliocene, as indicated by the relationship with Ricardo sediments. During the period of vulcanism, at least six flows of rhyolites-trachytes-latites, together with intercalated tuffs and agglomerates and several flows of basalt, were extravasated over the basement of what is now Soledad Mountain. The basaltic facies are localized on the southern outliers, and to date have not proved to be ore carriers. In the aggregate, the lava flows on the mountain proper are highly acidic, most of them showing prominent phenocrysts of orthoclase or quartz, or of both in a fine-grained glassy ground mass.

Ore Carrier Outcrops Easily Distinguished

The ore carriers weather to buff- or cream-colored bold outcrops, and are usually covered with green lichen. The uppermost members of the series weather to bold, massive, dark-brown outcrops, but are decidedly purplish on fresh surfaces, due to alteration products.

Excluding the basalts, whose relationships with the acidic members were not determined, the total thickness of acidic lavas is probably in excess of 1,000 ft.

In post-extrusive times, compressive, orogenic forces acted upon the lavas to push them into a gentle dome, with slippage over the underlying granitic basement. The limbs of this anticline dip about 15 deg. east and west, and the strike of the axial plane is roughly north-south. The folding was accompanied by fracturing in these competent rocks, with the more intense fracturing localized near the crest of the structure. In the most competent members the fracturing is marked by strong friction breccias, and it is apparently within these tension fractures and angular breccias that the oreshoots are localized.

That orogenic forces are still acting in the area is attested by the fact that the Soledad Mountain fault, outcropping on the east flank of the mountain, is apparently a live fault. This is suggested by the fact that the granitic gouge, where exposed to the atmosphere, is not materially dissected. The strike of this fault is about N. 20 deg. W., and the dip vertical. Two other well-defined breaks, probably post-ore in age, have been traced on the south side of the mountain.

The Intention fault strikes roughly N. 70 deg. W., and finds topographic expression in a series of saddles and topographic lows, known in California geology as kernbuts and kern cols. Apparently this fault has cut off the southern extension of the Karma vein system.

Even less is known about the Starlight fault. It strikes about N. 60 deg. W. and also finds marked topographic expression.

The extent of movement on either of these faults is as yet unknown, but the topographic expression, abrupt ending of the Karma vein system, and an occasional slickened outcrop of the fault plane, suggest that movement has been relatively great. The Starlight fault apparently does not cut the topmost flow, so that it finds topographic expression only where this flow has been stripped by erosion.

Various flows in the series have reacted in different degrees during folding and consequent fracturing. Those that have shattered more intensely—that is, the more competent members—have localized the large orebodies. Thus the Silver Queen orebody is localized with the Soledad rhyolite, a very competent rock.

Stott[1] and Roberts believe that cooling slump has played a significant rôle in bringing about normal or step faulting.

Minor structures, as jointing, sheeting, columnar structure and similar phenomena, although valuable as an aid to mapping, have not apparently had any direct relationship to orebodies.

Here it is necessary to mention a major structure which may play a considerable rôle in the future picture of Mohave—namely, the Cameron fault. This great rift is situated some 10 miles north of Mohave at the base of the Tehachapi range. Belief prevails that it is a rift similar to the San Andreas rift, with a vast horizontal component, and possibly a considerable throw as well. It is important here because its wide zone of granitic gouge may have acted as a dam or trap for normal alluvial drainage into the sink, and thus materially reduced the chances of developing water in sufficient quantities in the immediate vicinity of Soledad Mountain. Significantly, the only water at present available for milling is piped about 14 miles to the Standard ground.

Ore Deposition Apparently Epithermal

The economic picture in the Mohave area is neither clear nor definite, pending further study. However, the salient features as here outlined are believed to be essentially correct. On the basis of the evidence so far collected, the ore deposits of Soledad Mountain and its neighbors, the Middle Buttes and the Rosamond Hills, seem to fit into the epithermal classification; that is, they are relatively shallow, low-temperature deposits, localized in Tertiary acidic lavas. By far the greatest number of oreshoots are localized within

[1]Stott, Charles, and Roberts, Ed: Oral communication to author.

quartz veins, which occur as fissure, friction-breccia, and shear-zone fillings within acidic lava wall rocks.

With few exceptions, the veins of the district strike in a northwest-southeast direction. On the eastern half of the mountain, strikes approximate N. 20 deg. W., with steep easterly dips, there being local exceptions.

As one traverses westerly from the Karma ground over the Queen Esther toward the Silver Queen, the veins swing more towards the west in strike, so that the Silver Queen and Starlight strike N. 36 deg. W. and N. 40 deg. W., respectively. A reversal in dip west of the Silver Queen vein also occurs, so that the veins dip 55 to 60 deg. west.

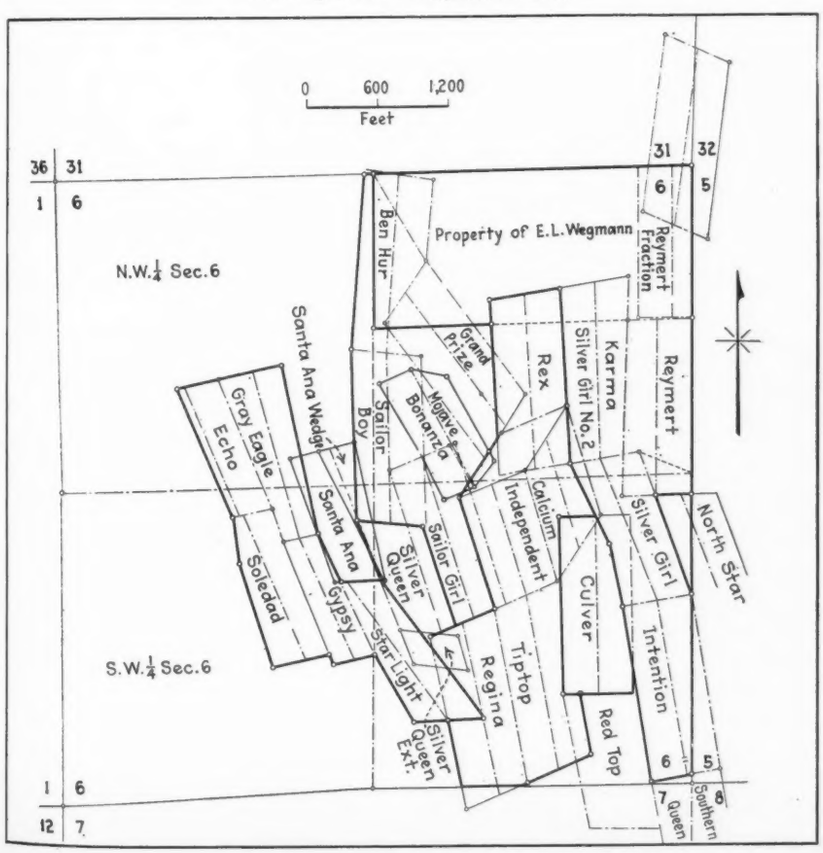
The Karma Vein System

The principal producer from the Karma ground has been the Karma vein. Its chief value has been in silver. It is a strong vein, from 3 to 6 ft. wide. It strikes about N. 15 deg. W., and in the upper workings dips steeply to the east, but in depth it rolls at least twice, so that reversals in dip are not uncommon. Its principal gangue mineral is quartz, occurring as the filling of a previously existing fissure. The values are apparently fairly well distributed across its width, with possibly a slightly higher concentration on the hanging-wall side. Cerargyrite, native gold, and an occasional bleb of argentite were the only megascopic ore minerals observed. Gangue minerals noted were colloform quartz, chalcedony, limonite, and an oxide of manganese.

Of uniform texture and structure, the Karma vein has walls that are occasionally indefinite, due to silicification at the contact. Banding is absent, but vugs and comb structure are not uncommon. The hanging wall is quite definitely a breccia that has been healed by siliceous solutions. Generally speaking, the richer oreshoots occur in the vicinity of more intense brecciation, due presumably to more open channels of circulation. Dominant wall-rock alteration is silicification.

Reymert vein strikes N. 17 deg. W. and dips about 60 deg. east. It is situated about a quarter of a mile north of the Karma mill and carries a good value in gold. Its ore minerals are interesting because of their diversification, and include gold, pyrite, chalcopyrite, cerargyrite, argentite, azurite (?), and iodyrite (?). Gangue minerals include quartz, calcite, ankerite, limonite, and chalcedony. This vein does not outcrop and has never been prospected. The collar of the discovery shaft is about 200 ft. below the mill level of the Karma (oxidized zone), but the ore minerals suggest a transition in the Reymert vein from the oxidized to the hypogene zone.

Property map of the Mohave district, showing the Silver Queen and adjacent claims



The other veins on the Karma ground, including the Ajax, although undeveloped, display characteristics similar to the Karma. All outcrops are bold where not masked by talus. Sulphide gossans are rare, but not absent.

The Standard Group

Standard ground is across the highway about one mile northeast of the Karma group. Its main vein is the Exposed Treasure, with a gold production in the past of several million dollars. In all, some seven veins of varying widths occur, most of them striking about N. 15 deg. W. Of these, the Exposed Treasure is the most westerly.

On the surface, this vein is localized at the contact between the granitic basement and an adjacent rhyolite flow (?), presumably because of the localization of pre-ore fracturing in a zone of weakness. The dip at the surface is about 55 deg. east. The vein is developed by an incline shaft which roughly follows the hanging wall down the dip. Approximately at the 400 level, it begins to flatten out and run into the granite, so that at the 1,000 level it dips about 35 deg. east and is localized within granite walls. Its outcrop is at least 100 ft. lower in elevation than the mill level of the Karma (oxidized zone), and the ore does not pass into the hypogene zone until a vertical depth of about 200 ft. has been reached. One might reason that the difference of elevation (300 ft. plus) between these points is a rough figure for computing depth of hypogene ore, using Karma mill level as the datum plane.

Dominant gangue minerals of the Exposed Treasure vein are colloform quartz, ankerite (?), and crystalline calcite. The main ore minerals are native gold, occasional cerargyrite, pyrite, and one or more complex sulphides as jamesonite or bournonite. Vugs and drusy cavities, crustified contacts, complex sulphides, calcite, chalcedony, calcite psuedomorphs, the silicified and sericitized wall rocks are all suggestive of the low temperature of the deposits. The ore is becoming more pyritic and erratic in depth.

Lack of time prevented examination of the other veins on the Standard ground, but A. J. Bruce indicates that they are similar in character to those of the Exposed Treasure.

The Silver Queen Mine

With the discovery of the now famous Silver Queen mine by George Holmes in the fall of 1933, interest again revived in the Mohave district, but the present activity did not take on the aspects of a boom until about November, 1934.

The remarkable Silver Queen vein has no outcrops and was discovered by luck plus smart prospecting on the part of Holmes. It is everywhere covered by talus from a depth of from 3 to 15

ft. and was uncovered by trenching. I have not been in the Silver Queen ground since September of 1934, and my observations, therefore, are based on field work as of that month, plus information received from Holmes and others covering development to the present.

At the time of examination, the deepest working was the 200 level. Then only about 6 ft. of the hanging wall was exposed, the strike of which was N. 36 deg. W., with a dip of 65 deg. to the east. The 200 drift was about 200 ft. long, with an average width of perhaps 12 ft. entirely in ore. With the exception of the exposure mentioned, neither wall had been located, in spite of 6-ft. sludge holes toward hanging and foot, at frequent intervals. Recent information indicates that the average strike of the lode is approximately N. 21 deg. W., with a dip of 60 to 65 deg. east.

The hanging wall is a cemented rhyolite breccia, extensively silicified. Rhyolite fragments in the breccia vary in dimensions from half an inch to as much as 5 in. The lode is frozen to this wall.

The ore is obviously in the oxidized zone, and according to recent information, still is, on the 300 level. Values are in both gold and silver, with a concentration of values in a rich 3-in. streak of cerargyrite on the hanging wall. The only ore minerals observed were horn silver, argentite, and native gold. Gangue minerals are colloform quartz, chalcedony, adularia (?), limonite, kaolinite, and an oxide of manganese.

Silicification is the dominant wall-rock alteration, plus extensive alteration of wall-rock orthoclase to kaolinite in the footwall. Banding is absent, but crustified contacts, drusy cavities, and comb structure are frequent. Selected samples of the vein quartz under the hand lens resemble a cemented breccia, which suggests that the vein was reopened and again sealed during mineralization. Post-ore shearing has fractured the vein and materially aided the processes of oxidation. Leaching is common at all horizons.

Without doubt the Silver Queen orebody is one of the most phenomenal and richest gold and silver deposits uncovered in years. Stope lengths exceed 500 ft., widths are greater than 10 ft., the ore is persistent to at least 350 ft., and these surprising dimensions are associated with ore of exceptional richness. In fact, one of the last cars shipped showed an average value of 0.89 oz. in gold and 26 oz. in silver.[2]

The south limit of the oreshoot has not been reached, and ore persists in all present workings to the south end line. The northern limit, however, has probably been attained, inasmuch as the ore is extensively brecciated, is becoming irregular, and in depth has died away to a few stringers each a few inches wide, which is characteristic of bottoming in the district.

[2]Holmes, George: Oral communication to author.

West of the Silver Queen

As previously mentioned, veins west of the Silver Queen, with few exceptions, dip west at steep angles, and the strike swings more to the west. North 40 deg. west might be a fair average for strikes on these veins. Likewise, the veins to the west become progressively smaller and leaner, until on the extreme westerly spurs of the mountain they are a few inches wide and of uncertain continuity.

Starlight ground adjoins the west side line of the Silver Queen, and carries at least three well-defined, massive, boldly outcropping quartz veins. These in general resemble those of the rest of the district, save that they are more massive, dense, and less sheared by post-ore movement. Occasional blebs of pyrite are not uncommon and values are good. Chief commercial metal is gold.

Gypsy, Soledad, and Soledad Extension lie west of the Starlight and the veins therein display similar characteristics.

I am unfamiliar with the ground between these claims and those on the extreme south and west, the last displaying the unfavorable characteristics mentioned.

Summary and Conclusions

1. Ore deposits of the Mohave district are epithermal deposits localized in Tertiary acidic lavas.

2. Oreshoots will probably bottom within a few hundred feet of the Soledad Mountain rhyolite.

3. Frequent bonanzas may be expected in individual veins.

4. Veins are localized by the filling of simple fissures, breccias and shears, although fading of values into the walls in some of them is suggestive of replacement.

5. Favorable horizons are the more competent flow rocks.

6. Bottoming of oreshoots is indicated by small, irregular bunches of ore and increase in pyrite.

7. Proximity to oreshoots is indicated in country rock by increasing amounts of limonite due to leaching of syngenetic pyrite and by stratigraphic horizon.

8. Careful geological study and mapping will probably reveal the locus of one or more other large deposits.

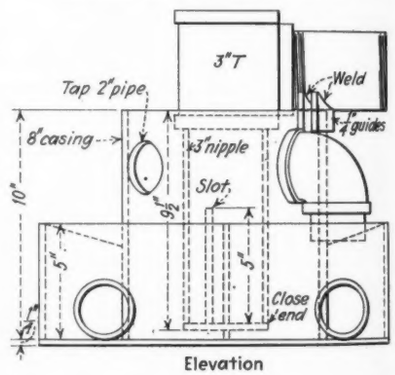
I wish to extend my thanks for the many courtesies extended me by the various operators in the district, in particular to George Holmes, discoverer of the Silver Queen; A. J. Bruce, E. L. Wegman, and Jesse Knight. I also wish to acknowledge the pleasant companionship and mutual exchange of ideas while in the field with Charles Stott, Ed. Roberts, and W. Val De Camp.

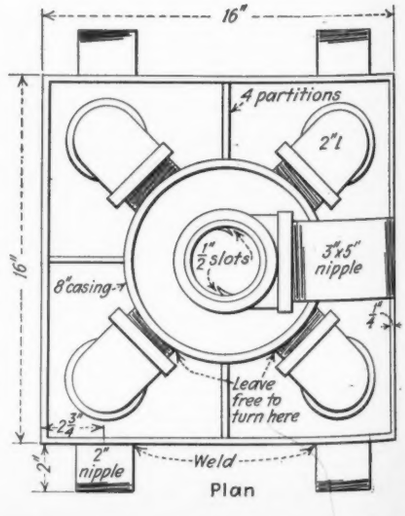
A Split-Part Ore-Pulp Distributor

THE accompanying illustration, writes Alfred B. Sabin, shows the design of an ore-pulp distributor suitable for capacities up to about three tons per hour. It may be used wherever necessity exists for dividing a pulp stream into as many as four parts equal in volume and consistency, which procedure is desirable in feeding a group of plates or other machines in parallel. The advantages of this design over most others lies in its simplicity, absence of moving parts, complete accessibility of all parts, freedom from clogging, high efficiency, and ease of control.

The high efficiency of splitting into parts equal in both volume and consistency is obtained by means of a whirlpool produced by introducing the pulp through vertical slots which are so turned that the pulp is given a peripheral motion as it leaves the feed pipe. Any plate or machine may be cut off by simply turning up one of the ells, in which event the remaining ells automatically carry the load. The distributor can be made in any mine or mill shop from scrap and a few pipe fittings.

The ore-pulp distributor shown here is useful when a pulp stream must be divided into four equal parts





NEWS OF THE INDUSTRY

World Copper Producers Reach Constructive Agreement

International Conference in New York Leads to Adoption of Three-Year Pact Whereby Production Abroad Is Substantially Reduced and Uniform Trade Practices Are Established—Stabilization of Foreign Market the Objective

"WHEN things are bad you endure them; when they become damn bad you do something." The world copper market has, in recent months, gone from bad to worse, and toward the close of last month world copper producers, after three weeks of deliberating in New York, agreed "to do something." Cornelius F. Kelley, president of the Anaconda Copper Mining Company, chairman of the international conference, announced on March 29 that an agreement limiting production outside the United States and establishing uniform trade practices in foreign markets had been reached by the group of conferees. In New York, the copper-trading center in this country, the agreement was generally hailed as one of the most constructive steps taken in the history of the industry.

The agreement restricts production abroad by 240,000 tons annually, effective on June 1, and terminating on July 1, 1938. Based on foreign production last year of about 1,120,000 tons, this will mean a cut of slightly more than 20 per cent. As the South American and African producers are expected to bear the brunt of the curtailment, the belief prevails that those interests will reduce operations by at least 30 per cent.

Excepting uniform trade practices governing sales, deliveries and terms of payment, the set-up for marketing copper abroad will not be changed. The agreement provides that "there will be no pooling of sales or fixing of prices, but an effort will be made to insure stable markets and avoid wide fluctuations in price."

The statement issued by Mr. Kelley follows:

"The principal producers of copper outside of the United States have been in conference during the past three weeks considering the problems of the industry in connection with the production of metal from sources outside of the United States and its sale in foreign markets. The conference dealt exclusively with the foreign situation and did not consider production or sales within the United States, from which market the participants are excluded by reason of the existing excise tax of 4c. per pound of copper and which market is covered by the Presidential Order approving the Copper Code.

"Notwithstanding the fact that the demand in foreign markets has been in excess of previous requirements, foreign production during recent months has been at a rate which if continued would not only retard the liquidation of existing surplus stocks of copper but add thereto, resulting in a wholly unsatisfactory price level in foreign markets.

"Participating in the conference were representatives of foreign companies having an aggregate current production of approximately 750,000 tons of copper per year, or more than 75 per cent of the total foreign primary production, exclusive of Russia and Japan, which import copper from outside sources in addition to their respective productions.

"The most important questions considered were production control, marketing methods, and trade practices. Complete accord has been reached upon all subjects considered, that is:

"1. A curtailment amounting to 240,000 tons of copper per year from current production will be made effective by June 1.

"2. An organization has been created to compile complete statistical information, to the end that while an adequate supply of copper will be provided at all times, the accumulation of excess stocks will be avoided.

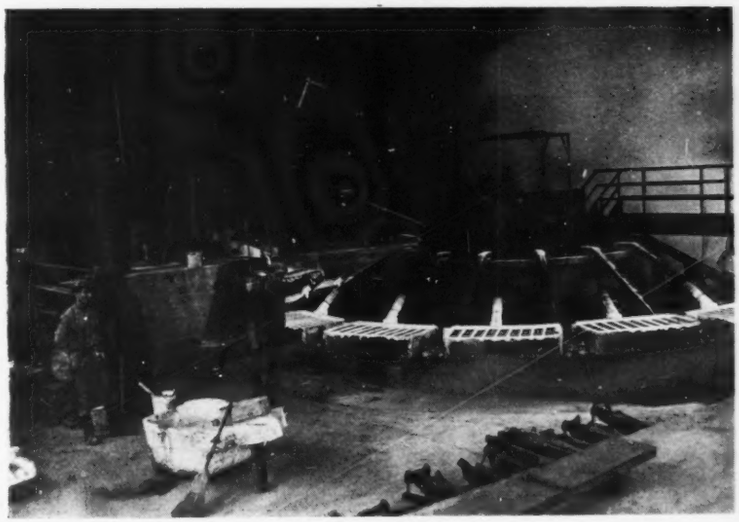
"3. Cooperation in foreign markets of producers other than those who have actively participated in the conference has been assured.

"4. Uniform trade practices governing sales, deliveries, and terms of payment will be adopted.

"5. Each producer reserves freedom

COPPER INGOTS IN THE MAKING. Casting wheel at an Atlantic Seaboard refinery. Blister copper, the crude metal product from the smelter, is melted in the furnace seen in the background and then poured into the molds mounted on the casting wheel.

Courtesy United States Metals Refining Company



of action within the above limitations. There will be no pooling of sales or fixing of prices, but an effort will be made to insure stable markets and avoid wide fluctuations in the price of copper.

"6. Subject to certain contingencies, the term of the accord is for a period terminating on July 1, 1938."

Signing of Zinc Code Features United States Developments

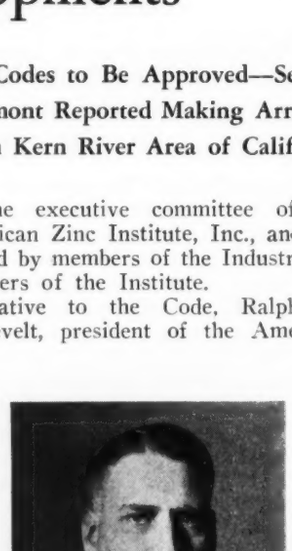
Last of Major Non-Ferrous Metal Mining Codes to Be Approved—Several New Large-Scale Projects Announced—Newmont Reported Making Arrangements to Exploit Extensive Placer Deposit in Kern River Area of California

APPROVAL of a Code for the Zinc Industry, to become effective April 8, was announced by the National Industrial Recovery Board on March 26. The Code provides a basic maximum 40-hour week averaged over three-month periods, at minimum wages varying between 30 and 47½c. an hour. The order of approval, however, limits the averaging provisions' operation to 60 days, at the end of which time the averaging provisions "shall be automatically stayed and the Code amended . . . to eliminate the said averaging provisions, or the said averaging provisions shall be superseded by appropriate provisions submitted by the Code Authority which shall conform to established Administration policy."

An eight-hour daily limitation is placed in the maximum-hours provisions of the Code, and the Board is empowered to name an impartial investigator "to review conditions in the Mining Division of the Industry and specifically concerning the application of the eight-hour provision in conformity with the State laws." The order of approval requires the impartial investigator to "review conditions in the Mississippi Valley, Southern and Southwestern districts of the Mining Division of the Industry for the purpose of reporting to the Board within 90 days from the effective date of this Code, the amount of adjustment of Code wages (not in excess of the recommendations of the Labor Advisory Board—35c. per hour above ground and 40c. per hour underground) possible in said districts . . . and that the Board, after reviewing said report and consulting with all interests concerned, may modify the minimum Code wage provisions for said districts of said Mining Division, as it may deem necessary upon the basis of said report." The Code rates are 30 and 35c. an hour, respectively, in all three districts.

The Code is to be administered by a Code Authority of six voting members, five to be selected from the members of the executive committee of the American Zinc Institute, Inc., and one elected by members of the Industry not members of the Institute.

Relative to the Code, Ralph M. Roosevelt, president of the American Zinc Institute, said, in the course of an interview with a representative of *Engineering and Mining Journal:*



RALPH M. ROOSEVELT

President,
American Zinc Institute

"All open price reporting has been eliminated from the Code and there is left nothing except the provisions covering wages, hours, health, and safety.

"The Industry is asking nothing and getting nothing from the Government in this Code, but is giving everything to the Government that it has asked for.

"Considering the fact that the Industry has had to operate at a greater capacity than consumption warranted during the past two winters, in order to take care of its men during the cold months, it has adjusted its schedules to the consuming demand about as well as could be asked.

"In the zinc oxide, lithopone, sulphuric acid, rolled zinc, and high-grade zinc divisions, stocks today are no higher than they were at the end of 1929, while the total stocks of slab zinc of all grades have increased from 75,430 tons at the end of 1929 to 118,075 tons at the end of February, 1935. Considering the efforts that the Industry has made to keep its workmen employed during the winter months, I think this is a pretty good showing; and, during the spring and summer months, stocks of slab zinc should decrease each month in preparation for again overproducing next winter if it is necessary to do so in order to care for its workmen, but we hope by that time consumption will have increased to the point where overproduction will not again be necessary.

"Ninety-nine and six-tenths per cent of the total industry signed the President's Recovery Agreement as modified for the Zinc Industry in July, 1933, at the very beginning of the Code activities, and has been, and will be, operating under that agreement until the new Code is effective on April 8. The Industry has done, and will do, everything possible to cooperate with the Government; but whether it has a Code or not, it will continue to conduct its affairs in a manner as intelligent and equitable as is possible for the benefit of its labor, its customers, and its stockholders."

Several new large-scale developments were announced in the various mining districts during the past month. These included a report that Newmont Mining is making arrangements to exploit an extensive placer deposit in the Kern River area of California. The company is said to have acquired 124 mining claims and 2,500 acres of placer ground from Kern River Mining & Development. A $250,000 gold dredge and a 75-ton mill are to be constructed. Arizona Comstock, operating a large open cut along the Comstock Lode in Nevada, is increasing its daily treatment capacity to 500 tons. Bunker Hill & Sullivan has taken a lease on a large area in the Selway region of Idaho, and American Smelting & Refining has re-entered the Joplin field as an active lead buyer after an absence of about ten years.

A summary follows of the more important news events that occurred in the various mining areas during March.

CALIFORNIA

• Burton Brothers, owners of the Tropico mine and a custom mill at Rosamond, are reported to have purchased the smelter completed recently at Mojave at a cost exceeding $70,000, and plan early removal of the equipment to Rosamond. The assay office operated in conjunction with the smelter is to remain at Mojave. Apart from the ore from the Tropico, the Burton Brothers' mill also treats ores received from the Neenach, Soledad, Middle Butte, Elephant Hill, and other districts of Kern County. At the mine, where 45 men

are employed, operations are centered on the 500-ft. level. Clifford Burton is in charge.

Russell Gold Mining, operating the Vista mine, near Angels Camp, is increasing the capacity of its mill by adding a battery of five 1,000-lb. stamps to the five stamps now available for crushing.

Placer mining operations continue to expand in the central and southern parts of the State. Yuba Consolidated Gold Fields is building a 9-ft. gold placer dredge near Biggs, Butte County, and Snelling Gold Dredging, headed by C. H. Thurman, of Folsom, and Merced Dredging, in which Natomas Company has a 25 per cent interest and a 50 per cent voting right, have each put into operation a new dredge in the Merced River placer-mining area near Snelling. The Merced company dredge was formerly the Natoma No. 2 in the Folsom field. It was dismantled late in 1934 and removed to Snelling to be provided with a new hull and then reassembled. In the Oroville district operations have been resumed by Oroville Dredging, following a brief shutdown of the dredge because of a broken digging ladder. A dragline and a floating washing plant have been placed in operation in the Mount Pleasant district, near Lincoln, by Virginia Placer Company. The washing plant, with a capacity of 100 cu.yd. per hour, contains a steel hopper, revolving trommel, sluices, and a tailing stacker. Sherman Tharp is in charge of operations.

News that has excited the interest of California mining men is a report that Newmont Mining is making arrangements to exploit a large placer deposit in the Kern River area. Through a leasing agreement, the company is said to have taken over 124 mining claims and 2,500 acres of placer ground from Kern River Mining & Development, and plans early erection of a large gold placer dredge, involving an expenditure of $250,000, and a 75-ton mill to treat ore mined from the mining claims. According to Los Angeles reports, tests on 300 acres of placer ground revealed values up to 80c. per yard, and depth of the gravel is said to average 30 ft. The property adjoins the Big Blue mine, a Bradley subsidiary, near Kernville.

Kennedy Mining & Milling has reopened its mine at Jackson after a four-months' shutdown caused by a strike. A small crew of men has been engaged for preliminary clean-up work. At the new 1,000-ton tailing plant employing the cyanide leaching process, operations are proceeding in a satisfactory manner, with 25 men employed under the direction of M. N. Colman, metallurgist, of San Francisco. The plant was completed late in February and consists of eighteen 42x12-ft. steel tanks and loading and precipitation equipment.

In the Grass Valley area, Empire-Star Mines is electrifying the main hoist at the North Star mine, formerly driven by compressed air, and has completed the foundations for the 500-hp. motor. Work also has started on sinking the 8,600-ft. North Star shaft an additional 200 ft. Idaho Maryland Mines is reported to have completed a new tramway at the old Idaho mill, which is treating ore from the Bullion mine exclusively. A rock crusher is to be installed on the 1,400-ft. level in the Brunswick mine.

Lava Cap Gold Mining, operating the Central and Banner mines, near Nevada City, is deepening the 1,200-ft. Central shaft an additional 200 ft. preliminary to development of known orebodies at depth. The mill is handling more than 200 tons of ore a day, with 135 men employed under the direction of Otto E. Schiffner, general manager.

Satisfactory progress is being made at the Spring Hill mine, at Grass Valley, in sinking the 200-ft. winze on the 900-ft. level. Development plans also include connection of the Spring Hill workings with those of the Golden Gate mine, which the company acquired recently. H. R. Plate is general manager of Spring Hill Gold Mines.

Development of an 8-ft. vein of good milling ore for 800 ft. on the 800-ft. level in the Empress mine, near Grass Valley, has been announced by E. C. Jacobs, general manager. Anticipating a larger output from the mine, the company has increased the capacity of the mill to 350 tons by installing a second ball mill. The property is owned and operated by Republic Gold Mining.

The new 300-ton flotation plant at the Big Canyon mine of Mountain Copper, near Shingle Springs, Eldorado County, completed late in December, 1934, has been operating successfully ever since, with a capacity averaging 250 tons per day. In the mine, development work proceeds according to formulated plans, which include considerable diamond drilling. The new surface plant is perhaps the most modern in California, and all buildings are of steel-frame construction and fireproof. The mill flowsheet is similar to that of the flotation mills erected recently on the Mother Lode and in Grass Valley; the primary and secondary crushing, done in an Allis-Chalmers jaw crusher and a 4-ft. Symons cone crusher, respectively, is followed by fine grinding in two 7x6-ft. Allis-Chalmers ball mills operating in closed circuit with two Dorr mechanical classifiers. The 60-mesh classifier overflow is treated successively in a conditioner tank, a five-cell Fagergren flotation machine, a one-cell Fagergren cleaner, a Dorr thickener, and an 11½x6-ft. Oliver filter. Concentrate is trucked to Stockton, and thence is shipped by steamer to the Tacoma, Wash., smelter. J. M. Basham is general manager of the Big Canyon unit of Mountain Copper.

Annual Zinc Institute Meeting in St. Louis, April 22-23

THE seventeenth annual meeting of the American Zinc Institute will be held at the Hotel Statler, St. Louis, Mo., on Monday and Tuesday, April 22 and 23.

Monday's meeting will cover, among other things, the problems the zinc industry is facing, including relation of the mining and smelting branches of the industry to each other, and the relation of the entire industry to the Federal Government.

Tuesday's meeting will be entirely given over to the industry's galvanizing campaign, its accomplishments, its failures, and its future.

Entertainment features of the meeting will again be in charge of Edward J. Greve.

All members of the industry are being urged to attend the meeting, as the Institute feels that the success of the industry at this time depends more than ever before on the cooperation of all its members.

MONTANA

• Montana Consolidated Mines has resumed operations at its Spring Hill mine, about 4 miles south of Helena, after settling its labor difficulties. The company has a larger operating plant than any other gold-quartz mining company in the State and is employing 60 men. The mill consists of both coarse and fine flotation sections, the larger gold particles being recovered in the first section.

Morning Glory Mines, operating near Basin, Jefferson County, has increased its force to 22 men. Besides shipping high-grade ore, the company is putting gold and silver milling ore on the dumps, as it expects to build a mill.

Fairview Syndicate, operating in Madison County, has just opened up a new body of ore that contains substantial quantities of gold and silver. Shipments will start early this month.

Basin Montana Tunnel, operating 5 miles northeast of Basin, Jefferson County, is putting 160 tons of ore per day through its flotation plant. Operations of the company were recently inspected by Raymond Brookes, consulting engineer, of New York. Mr. Brookes was formerly general manager of Rhodesian Congo Border Concession, of England and Africa. While in Butte he addressed a luncheon group on the subject of the copper developments in Rhodesia. Mr. Brookes was a guest

of William H. Hax, president of Basin Montana Tunnel, and several stockholders in the company, including James Brookes, member of the New York Stock Exchange; Martin Fenton, of the Stock Exchange firm of Laird & Company, and J. W. Hullick, representing securities investment interests of New York City.

Through the efforts of operators and the Mining Association of Montana, all the bills adverse to mining that were brought up in the recent Montana Legislature were eliminated.

UTAH

• Construction of a 12-mile branch of the Union Pacific branch railroad from Desert Mound to Iron Mountain, 24 miles southwest of Cedar City, Iron County, was started April 1. This is the first step in the development of Columbia Steel's extensive iron deposits at Iron Mountain for shipment to the company's Ironton plant, between Springville and Provo. As a result of this program of expansion, nine months' work for a large crew of men is made possible. A primary and a secondary crushing plant are to be constructed, as well as buildings and offices. Stripping of the orebodies also must be completed. In addition, the State Road Commission is to build 16 miles of road to the Iron Mountain deposit. During the last eight years the company has been purchasing its ore from the Utah Iron Ore Corporation's open-pit mine at Desert Mound.

Officials of Manning Gold Mines are considering plans for increasing capacity of the milling plant at Manning, so that it may treat 1,400 tons daily, as compared with the present capacity of about 700 tons. Favorable developments at the Lewiston Peak Mining properties at Mercur, 7 miles distant, where a 7-ft. bed of gold ore has been opened up and where tailing dumps containing 4,000,000 tons exist on the old Consolidated Mercur Mines property, have caused company officials to draw up plans for increasing the size of the cyanide plant. The new double-compartment shaft at Lewiston Peak Mines has reached a depth of 350 ft. Three tunnels are being opened in the Mercur Mines property, where a large tonnage of base ore is being developed. The company is considering the installation of a roaster, to drive off the arsenic and sulphur, before treatment at the Manning plant. About 700 tons of tailing is being treated daily at the Manning plant.

Attempts in the Utah State Legislature, which adjourned March 18, to increase the rate of taxation of metalliferous mines failed. Arguments of leading Utah mining men that metal mining is one of the State's greatest resources, and that the industry was already bearing its fair proportion of the tax burden, defeated the opposition. A bill, providing for "reasonable reductions" for smelting, mining, and freight costs, and reducing the exemptions for salaries of officials, passed the Senate with the clause deleted proposing to base assessed valuation on the sum of the net proceeds for the three preceding years. The measure died in the House during the rush of closing days, so that assessed valuation for taxation on orebodies stands unchanged at the rate of three times the net proceeds for the year next preceding that for which the tax is to be computed. In addition, mines pay a tax on the assessed valuation of surface improvements and $5 an acre for mining claims.

High-grade ore has been opened up on the 2,050 level of the Mammoth mine, in the Tintic district. Shipments carry from 0.3 to 1 oz. of gold to the ton, as well as small amounts of silver and lead.

A carload of ore shipped by leasers in the Horn Silver mine, Frisco district, near Milford, carried $1.70 in gold, 44.5 oz. in silver, 11 per cent lead, and 3½ per cent zinc to the ton. Development in the King David mine, adjoining the Horn Silver, is cutting a highly mineralized formation. The shaft of the Frisco Silver Lead mine is being retimbered and a new hoist installed preparatory to extending the shaft to the 500 level.

A new hoist and compressor have been installed at the East Utah Mining property in the Park City district, under the direction of J. W. Lamb, president. Sinking of the shaft to a depth of 400 or 500 ft. to prospect the McHenry fault and associated fissure systems has been started. The company is also driving a tunnel to explore the Wasatch fissure.

Prospecting operations have been resumed at the Lehi Tintic mine, in the East Tintic district. Work of extending the main tunnel has been contracted to Amber Gray. Objectives are the Lehi Tintic and Gold Blossom fissures.

Work has been suspended in the Apex Standard property of Chief Consolidated Mining, in the East Tintic district, for three or four months, according to Cecil Fitch, general manager.

MINNESOTA

• Open-pit mine shops are busy these days getting locomotives and shovels in good condition for the next season's operations, although no definite notice have been received as yet concerning the tonnage to be shipped. Some changes are being made in the experimental magnetic concentration plant operated jointly by Butler Brothers and the United States Bureau of Mines Experiment Station, which shipped 4,652 tons of concentrate last year. Some machines in the plant are too small to allow maximum production, and these are being replaced with larger units. At Hibbing, Oliver Iron Mining is making a cut between the Morris mine and the Burt-Day-Pool group which requires the re-routing of the highways and grade reduction on pit tracks.

Service medals for employees serving for 25, 30, and 35 years were awarded recently by Oliver Iron Mining. The number so honored is as follows: nineteen received the 25-year medal, twelve the 30-year, and nine the 35-year medal. These medals bear the likeness of Judge Gary, who started the system of awards in 1927 and extended it throughout the United States Steel Corporation.

Certificates of honor for safety achievement during 1934 were awarded by the Joseph H. Holmes Safety Association to the following Mesabi range mines: Mahoning, at Hibbing; Scranton, at Hibbing; Biwabic, at Biwabic, all three operated by Pickands Mather; the Mesabi Chief, at Keewatin, an M. A. Hanna property; and the Hoadley-Mace No. 2, of Nashwauck, a Butler Brothers operation.

Susquehanna Ore, operating the Susquehanna mine, at Hibbing, has won a suit from the State Tax Commission before the Supreme Court of Minnesota in which royalties of $12,860 were assumed by the ore company but which the Tax Commission claimed were incorrectly charged. This decision may develop a loophole for some of the operators to secure relief from excessive royalty taxes.

NEVADA

• In driving a drainage tunnel to connect with the bottom of a 500-ft. shaft, a gold-bearing vein of promise has been exposed on property of Atlas Gold Mines, in the old Edgemont district, northern Elko County. A 4,200-ft. flume conveys water to the newly constructed 50-ton flotation mill, supplying power for a hydro-electric plant. H. H. Carpenter, of Pasadena, Calif., is president and manager.

High-grade silver ore is being shipped by lessees working on the Garfield mine, in Mineral County. The mine, long idle, is credited with an output of $6,000,000 during the 'eighties. The lease workings, at the west end of the large group, adjoin the Mabel mine of West End Consolidated, of Tonopah, a producer of high-grade ore.

Plans of Arizona Comstock, which is treating 350 tons of ore per day from its huge open-cut in the outcrop of the Comstock lode, involve immediate completion and enlargement of its tailing cyanide plant to 500 tons' capacity, additions to its flotation mill giving similar capacity, and about 4,000 ft. of additional development work. Ore from the open-cut, now 900 ft. long and more than 100 ft. wide, has averaged around $6 per ton. Recovery by flotation has been only 65 per cent of the gold and 52 per cent of the silver, whereas a recovery of 94 per cent of the total is indicated with cyanide leaching of the

• Stamp mill and compressor building on the Original Mining & Milling property along the Mother Lode in California, recently acquired by the San Juan Ramsey Company. Two shifts are being worked on the Ferguson vein and five leasers are working the Original vein on the adit level. A tunnel, the company reports, is also being driven near the top of the mountain to tap a high-grade vein formerly worked by Mexicans before California became a part of the United States

tailing. Flotation tailing has been impounded for future treatment in the cyanide plant, and a smaller cyanide unit will treat the flotation concentrate, effecting a saving estimated at $45,000 to $52,000 annually, as against shipping this product to smelters. Within little more than a year, up to March 1, the flotation mill had treated 100,338 tons of ore having a gross value of $587,631. The open-cut operation has proved highly successful. One day recently the trucks delivered to the coarse-ore bin 410 tons sampling $11.60 per ton. This ore is mined with a 1½-yd. gas-driven shovel and transported about 1,500 ft. down grade to the mill in 10-ton trucks.

Renewal of activity in the Scossa district, Pershing County, is indicated with the resumption of work by Dawes Gold Mines, first operation of note in the district and producer of a number of carload shipments of high-grade gold ore. E. M. Dawes, president, has been at the mine, and a crew of miners has been employed. According to reports, work will also be resumed on the adjoining Scossa Red Top property, which is well equipped and contains developed ore of good mill grade in its main shaft and drifts.

On the level of its deep transportation tunnel, Como Mines has opened high-grade gold-silver ore 3 ft. or more wide that is remarkable for its content of ruby silver; the brecciated and compactly recemented quartz is thickly spotted and seamed with the pyrargyrite crystals. The vein, apparently the extension east of the main Como vein thrown some distance to the north, has the typical filling of the district fissures in andesite, but this ore, opened for a length of about 30 ft., is the richest found at depth in the mines. Mill designs have been completed by Arthur E. Wheeler, of New York, and excavating for foundations is scheduled to begin soon. The reserve of mill ore blocked above the haulage tunnel is estimated at 1,500,000 tons.

Largest producer of tungsten in the United States is Nevada-Massachusetts, operating mines in Pershing and Mineral counties. Prospecting at depth for additional orebodies in the Pershing County mine with long core drills is in progress under contract with the Chicago Pneumatic Tool Company. The work is being directed by T. H. Pitt, western representative of Chicago Pneumatic. Officers of the General Electric Company, from Schenectady and Cleveland, have inspected both mines lately. General Electric is said to purchase a large part of the concentrate from the plant near Mill City. Otto F. Heiser is manager for Nevada-Massachusetts.

Two groups of claims in the Ramsey district, northern Lyon County, have been acquired under working option by Reorganized Booth, of Goldfield, and Halifax Tonopah. Shafts are being reconditioned in preparation for deeper work. Lahontan Mines, owner of the Ramsey Comstock mine, is operating a 50-ton cyanide mill with success. Parker Liddell is manager.

White Caps Gold Mining reports a total 1934 income of $40,547, including $24,812 from lease royalties. Additional income was revenue from operations of a syndicate in which the company has a one-third interest that operates a cyanide plant treating tailing from the old mill. Homer L. Williams, manager, reports that lessees working on levels from the 200 to 1,100 produced 6,028 dry tons of ore containing 6,095 oz. gold, with a gross value of $219,167, or $36.36 per ton. This product was trucked to Tonopah and shipped to the American Smelting & Refining smelter at Garfield, Utah. Deep levels contain little arsenic, whereas the content on upper levels of realgar and orpiment has defied local treatment, and much effort has been expended in endeavoring to work out a process by which the White Caps ore can be treated on the property. Negotiations looking to the absorption by White Caps of several adjoining properties were said to be progressing.

Provision has been made to recondition and enlarge a 50-ton cyanide mill on property in the Comstock district acquired by the lately organized Big Comstock Mines, controlled by Detroit interests. Part of the large group of claims was formerly embraced in holdings of the old Comstock Home Mining, idle for about ten years. The mine has produced ore of good mill grade from the Brunswick lode, a mile east of the Comstock lode. R. A. Bishop is manager.

Gold-silver ore of high shipping grade is being sacked for shipment to a Utah smelter in a winze from the 300-ft. level of the Buck & Charley mine of Rochester Plymouth Mines, at Lower Rochester, Pershing County. Construction of a 50-ton mill is in progress, and Carl Stoddard, consulting engineer, has reported a large tonnage of available ore of exceptionally high mill grade, in addition to the product of shipping grade.

Starting a month earlier in the season than has been usual in the seven years of operation, the tailing cyanide leaching plant of Bradshaw, Inc., treating tailing from the old 100-stamp cyanide mill of Goldfield Consolidated Mines, is operating at capacity. When it closed for the winter the plant was treating 1,400 tons per day.

IDAHO

• Bunker Hill & Sullivan has taken a lease and option on a group of claims in the Selway mining district of Idaho County. The transaction is one of the largest made in the Selway region for many months and is attracting much attention to that district. In the lease and option filed with the county recorder at Grangeville the sum of $60,000 is to be paid the owners by the latter part of August, 1936, on the Walter Smith and May Stephens group, the money to be paid in installments. Under a similar proposition, $15,000 is to be paid Walter Smith and Henry Fouls for two more claims known as the Purple Star group. Development work is under way on the property by the Bunker Hill company, with Ed Kevern, field engineer for Bunker Hill, in charge of operations.

Modern haulage equipment, consisting of a Manchu storage-battery locomotive and Timkin side-dump cars of 20-cu.ft. capacity, has been installed at

the Lone Pine mine, at Golden, Idaho County, the second largest gold producer in Idaho, and extensive development work is planned for the coming season, F. O. Miller, of Clarkston, president, and S. O. Miller, of Lewiston, in charge of operations, have announced. Production will be resumed this spring. The development work includes lowering the working level of the shaft from 110 ft. to 200 ft., where drifts will be run to develop and block out orebodies on four veins which are being worked on the higher level. Drifting will be continuous, S. O. Miller said, following the vein system farther under the mountain. Eventually, he declared, a vertical depth of 950 ft. from the surface to the main working level will be attained.

Gold-mining activities in the Salmon River region, from Whitebird to Lucile, are expanding rapidly, with the outlook bright for the busiest season known in that section for a long time, according to Roy H. Kingsbury and W. H. North, who inspected properties along the river. Efforts to save the fine gold found in the river channels and old bars have occupied the attention and study of many well-versed mining men, and as a result some unusual methods are to be found along the rivers. Considerable gold is being recovered even from the crude rockers, with the more scientific methods showing better results.

Lead ore from the Jack Waite mine is going to the East Helena plant of American Smelting & Refining, following termination of the lease with the Bunker Hill smelter at Kellogg. The zinc product goes to the Sullivan electrolytic plant at Kellogg. The mine is operated by American Smelting & Refining on a long-time contract. A long tunnel is being driven by the company through the divide from the Idaho side to a terminal on the Montana side, which tunnel will afford an outlet to the Northern Pacific Railroad by means of a 15-mile truck haul to White Pine.

Operations in the lower crosscut tunnel at the Mineral Mountain property on Spring Creek were started under the management of Fred Thiel. Expectations are that the crosscut will intercept the vein within 50 ft., and a drift will then be carried directly into the mountain to reach a point beneath the upper workings where silver values were exposed. The company owns a group of patented claims adjoining the Polaris and the Chester properties in the "dry-ore" belt.

Native copper, a rare mineral in the Coeur d'Alenes, was recently disclosed in the shaft operations at the Metropolitan mine, on Big Creek. The copper occurs with the silver in the vein. R. S. Merriam, manager, reports that the shaft has passed the 80-ft. mark. Footwall gouge, he states, is fully a foot in width, as compared with two inches at the collar of the shaft. The vein is wide, the hanging wall not being in sight.

• Mining camp of Basin, Mont. To the right is Basin Creek Gulch, in which several small mines are situated. The Jib Jib mine is at A, and the Basin Goldfield property, on Pole Mountain, is at B; the difference in elevation of the two properties is 1,200 ft. On the mountain may be seen the flue and stack of Glass Brothers' smelter, which was never used

At the Polaris property, under development by Polaris Development, in which company Hecla Mining is the principal factor, the shaft has reached a depth of 700 ft. The management is also driving steadily in the crosscut from the Silver Summit property, which crosscut will reach the Polaris shaft at a distance of 4,800 ft. and at a depth of 1,040 ft. below the collar of the shaft. This is one of the major development operations under way in the silver belt and is being watched with much interest.

F. M. Rothrock, president of Dayrock Mining, in a letter to the stockholders, explains the need for an assessment of 6 mills per share recently levied by the directors. He states that the company ran in debt nearly $10,000 to meet its non-operating expenses and that the directors were forced to borrow the money to meet these bills. The mine has been closed since the depression started, being one of the first to cease operations, and has remained idle since early in May, 1931. Prior to its shutdown, from 50 to 75 men were employed and shipments were regular, with a net profit record of $538,250, a part of which was paid stockholders in dividends. Mr. Rothrock also states that the directors have authorized the manager to lease such portions of the property the mining of which in his judgment would not interfere with future company operations when metal prices permit a profit.

Placer miners of the Murray section are preparing to take advantage of the early high water in ground-sluicing operations, and expect to have one of the best seasons in years. Various methods will be employed. In some instances pipe lines a half mile in extent have been installed to take advantage of the water as long as possible. With a solid pack of snow in the hills, the outlook is for an extended season.

Concentrate from the mill of Sunshine Mining is reported to contain from 800 to 1,000 oz. of silver per ton. After leaving the Sunshine mill the concentrate is treated in a special unit at the Bunker Hill & Sullivan plant, where its bismuth content is removed. The concentrate then goes to the Bunker Hill smelter. A comprehensive underground program has been mapped out for the Sunshine mine by Manager Eichelberger. This program, which extends over the next two or three years, includes sinking a vertical shaft to the 3,100-ft. level. Through this shaft ore will be hoisted directly to the surface. The hoist to be employed will be capable of operating to a depth of 5,000 ft. Sinking of this shaft will be undertaken from three levels simultaneously. From diamond-drill reports, the management states, indications point to no geological

RFC Authorizes More Loans

Two mining loans were authorized in February. One for $160,000 was for the Sutro Tunnel Coalition, of Virginia City, Nev. The other was for $8,000 for Southwestern Metal Mines, of Cleator, Ariz. Two additional authorizations were made in March, but the policy of the RFC is to make no announcement until its monthly report is made to Congress. The understanding prevails, however, that one of the March loans was for a large placer project in California.

reason why the orebody will not persist at least to the 4,000 level without material change in either size or value.

Operations have started on the Elgin & Ogden property, on Big Creek, a short distance north of the Sunshine mine. The work is under the supervision of Fred Foster, of Seattle, who recently secured a bond and lease on the property. He plans to sink a 500-ft. shaft and to explore the vein, exposed in the tunnel level, at depth. The Elgin & Ogden group of five claims was located by Wesley Herring many years ago. About 1,000 ft. of driving has been accomplished in two tunnels, both of which exposed a well-defined fissure vein carrying silver, copper, and lead.

ARIZONA

• Consolidated Gold Mining has completed the dewatering of the United Western mine, near Oatman. Several stopes of milling ore were found to be available for immediate extraction from the 700-ft. level. Ore is to be shipped to the Tom Reed mill, which is installing a 125-ton bin to handle this new tonnage. More than $500,000 in gold has been shipped by Tom Reed in recent months, according to O. R. Howard, president. The gold has been extracted from company ore, lessees' production, and custom shipments from other companies in the district.

Arizona Molybdenum Corporation is operating its mill near Copper Creek at capacity, treating 150 tons of ore daily. About 100 men are employed in mining and milling, under the direction of H. Hendrickson.

Black Canyon Mines, at Cleator, is installing two Fagergren flotation cells in a 25-ton mill for the production of a bulk concentrate from a zinc-silver ore.

Weber Brothers are operating a two-stamp amalgamation and concentration mill at the Pine Grove mine, near Prescott.

Black Rock Gold Mining plans to erect a 40-ton flotation mill. The property, adjoining the Monte Cristo, has been opened by 900 ft. of mine workings, with 340 ft. the greatest depth attained. Recently the shaft has been repaired, a gallows frame erected, the hoist foundation poured, the mill site excavated, a compressor installed, and the underground workings have been reconditioned. A. Lytal, of Wickenburg, is manager.

Gold Sovereign Mining is developing a placer deposit near Kingman. Churn drilling will be followed by the driving of an 800-ft. tunnel to reach the gravel bed.

Ore is being shipped from the Golden Slipper, at Morristown, by Jack Regan, who is operating for the new lessees, E. J. Broberg and R. R. Weaver, of Phoenix.

Stoping operations on the 50- and 100-ft. levels of the Pope mine, 30 miles north of Chloride, are supplying ore for regular shipments. Calizona Operators are shipping gold-silver concentrate from the Weaver and Mutual mines to the United States Smelting, Refining & Mining Company at Salt Lake City.

Johnson Mining is moving lumber and equipment over the newly constructed road to the property on Weaver Creek, 3 miles north of Octave.

Golden Belt Mines, at Cordes, is producing a high-grade concentrate from the 40 tons of ore milled daily. Golden Turkey is installing a Denver cell in the flotation circuit of the 75-ton mill.

An ore depot will be opened at Wickenburg to purchase small lots of ore to be combined into carloads for shipment.

Samoa Gold Mines has completed the truck road to the property, 3 miles east of Chloride. Prior to 1908, this was the most active producer of gold and silver in the district. The ore was packed out on burros for shipment to the smelter at Needles.

Gold Gulch Placers, 6 miles from Oatman, in the bed of Silver Creek, are treating gravel in a wet shaker machine.

National Gold Corporation is planning to reopen the Midnight Test mine, near Prescott, according to W. W. Linesba, president and general manager.

Output from the Big Jim mine, at Oatman, has been increased from 35 to 50 tons a day. The mine has been equipped with an electric hoist to increase production from the lower levels.

Advisory Board Meets April 25

The new Bureau of Mines' Advisory Board, the membership list of which was published in the preceding issue of *Engineering and Mining Journal,* has been called to hold its initial meeting in Washington April 25.

KAN.-OKLA.-MO.

• The unwatering of the old Oronogo district, in Missouri, by Frank Childress and associates, was brought to a halt on March 10 when district streams were sent to flood stage by torrential rains, despite the fact that two additional Pomona pumps had been installed. The water, which had been receding at the rate of about 6 ft. a week, registered a gain of 4 ft. in the week ending March 16. Four pumps are being operated in the Oronogo bottoms by Childress and associates which are throwing about 12,000 gal. of water a minute, or about as much as all of the mines in the Oklahoma section, the active section of the Tri-State district, are pumping.

The rains flooded Leonard Goings out of the old Peacock district, northwest of Joplin. He was operating two centrifugal pumps at Peacock, which were throwing about 1,000 gal. of water a minute. The water had been beaten to the 50-ft. level when Spring River overflowed into the old cave-ins at Peacock. Mr. Goings will continue operations.

Charles Osborne and Dick Wills, of Miami, have obtained a lease on the old Blue Bell mine, at Wentworth, Mo., 30 miles east of Joplin, and have unwatered the old workings. Underground development work is being done at the property. If the development work is successful, a mill will be built on the lease.

Beck Mining, whose No. 3 mill, on East 19th St., Baxter Springs, Kan., has been idle since the latter part of last year, has converted the mill into a tailing plant and is re-treating the tailing from the Ebenstein mine, northwest of Baxter Springs. The Ebenstein was one of the properties worked by Chanute Spelter, a subsidiary of American Metal.

Commerce Mining & Royalty is erecting a derrick and hopper on the Smith-Crane land, southeast of Hockerville, Okla., and will run the ore from the lease over its Bird Dog mill. The ore will be hauled by truck.

American Smelting & Refining has reentered the Joplin market as an active lead buyer after having been out for about ten years. L. G. Johnson, district superintendent of Federal Mining & Smelting, A. S. & R. subsidiary, is acting as buyer.

MICHIGAN

• The corporate existence of Keweenaw Copper has been extended for another 30 years by the stockholders, and the par value of the stock reduced from $25 per share to $1 to more nearly conform to present day values. There are 400,000 shares, with about 84,000 outstanding. Offices of the company have been moved from Calumet to Hancock.

Water in the shaft of the Ropes gold mine, near Ishpeming, which is being reopened by Calumet & Hecla Consolidated, has been lowered to 500 ft. Installation of a new centrifugal pump at the eighth level will expedite the dewatering from this point. The shaft is 850 ft. deep, with fifteen levels. On the surface, a new engine house has been erected and foundations have been built for hoist and compressor. Present surface equipment is of a temporary nature and will be replaced when actual work starts underground. Territory adjacent to the shaft will be thoroughly explored. The geology is considered favorable.

Organization of the National Copper Paint Company, an Illinois corporation, to manufacture and market copper paint, is announced. H. M. Rice, manager of the Nichols Copper Company, a unit of the Phelps Dodge Corporation,

is president of the new firm, and Frederick A. McLauchlan, president of George B. Carpenter Company, is secretary and treasurer. The company has rented 50,000 sq.ft. of manufacturing space and expects to add to its facilities. A new method is claimed, whereby copper can be reduced to an amorphous form and applied as a copper paint, 98.6 per cent pure metallic copper.

The first attempt in Michigan to rehabilitate a community which has lost its principal industry has been started at Gay, Keweenaw County, in the Lake Superior copper district. Residents of the little village have been without regular employment since the final closing of the stamp mill of Mohawk Mining. Gay Industries, Inc., a cooperative organization formed under the rehabilitation section of the Federal Emergency Relief Administration, has started operations, with 54 members. Various industries, designed to take men off relief rolls and create employment, will be established. Equipment for a fishing industry, including 100 lake trout nets and 50 herring nets, has already arrived. A 27-ft. surf boat, formerly used by the coast guard, has been obtained, and another, 38 ft. long, will be purchased. Plans call for the ultimate purchase of freezing and canning equipment. Smoked fish also will be added to the list of products. Later in the year, the canning of vegetables and berries will be undertaken. Three buildings have been purchased from Mohawk Mining to aid in the establishment of the various small industries. Wood-working equipment for the manufacture of fish boxes and other products will be added later. Manufacture of skis, toboggans, hockey sticks, snowshoes, and cedar baskets also will be carried on in these buildings. Looms for carpet weaving will be installed. Under the federal plan, members of the organization pay a membership fee of $5. A Government grant is made to launch the enterprise and purchase necessary equipment. Thus, the Government owns everything until the grant is repaid. Those engaged in fishing will earn wages and will be taken off relief rolls at once. The products of the varied enterprises will be exchanged for surplus food and bartered for other commodities and services.

Mexico Endeavors to Rehabilitate Workers in Mining Areas

STIMULATING the mining industry by intensifying mine work in various parts of Mexico and organizing competent miners, who lost their jobs when companies abandoned mines, into cooperative societies to exploit such abandoned properties, is a feature of his program this year, President Lazaro Cardenas said in a recent interview. . . . Confederation of Workers and Peasants of Mexico, a strong labor organization, has submitted to President Cardenas a list of all abandoned mines and mining properties in the country, with a petition that he afford miners who were dismissed when work was suspended on these holdings facilities to exploit these properties on a cooperative basis.

The first carload of ore has been shipped from the Alcaparra mineral lots, Villa Ahumada municipality, Chihuahua, where work was recently started, to the smelter at Torreon, Coahuila. . . . Work has also started on the Don Jorge mineral tract, Nacozari municipality, Sonora. . . . Owners of mineral tracts, ranging from one pertenencia to three pertenencias each, in Hidalgo, Zacatecas, and Guanajuato, have asked President Cardenas to reduce annual taxes of from three to four pesos (about 85c. to $1.28) per pertenencia, which they aver only large companies can afford to pay and make a profit.

Mining production in the Zacualpan region, Mexico, has been stimulated as a result of contracts made with American Smelting & Refining for the purchase of ores produced in that zone, which are treated at the company's smelter at Angangué. . . . Near bonanza times are reported in the Sierra de Durango, Durango, mining region, with the reopening of mines that were worked before the revolution but which had been abandoned since then. Most of this activity is in the Velardeña zone.

Republican Mining has resumed work on several tracts near Cuencamé, Durango. Work has also been resumed on the Huasteca mineral tract, near Santiago Ixcuintla, Nayarit; the El Comal and La Linterna gold, silver, and lead tracts, Sultepec, Mexcio; at the old Rosario mine, in Vera Cruz; on the San Luis tract, Moctezuma district, Sonora; and the Magdalena 1, Magdalena 11, San Jose, Socavon Valveria, Reina 1, Reina 11, San Miguel, El Gachupin, Trinidad, La Purisima, and Gachupin Donastiya tracts, Temascaltepec region, Mexico, which had been idle for ten years. . . . Preparations are being made to resume work in the San Francisco and Tlalchichilpa silver mines, at Huautla, Morelos. . . . Several hundred men are conditioning a mercury mine at El Soyotal, Toliman municipality, and an antimony mine at Cadereyta, both in Queretaro, for work at an early date. . . . Cia. Mexicana de Mercurio, reports that sufficient metal is in sight to keep its mines at San Miguel-El Cerro, Zacatecas, and at Santa Rosa, Morelos, operating for some time.

● New cyanide-flotation mill of Suyoc Consolidated Mining Company, about 95 km. north of Baguio, Philippine Islands, which was recently placed in operation. Capacity of the mill is 150 tons daily, but the mill can readily be enlarged to provide double this capacity. Ore is hauled to the ore bins by truck over the road seen in the upper left. Shipments of bullion from the property have begun

NEWS FROM WASHINGTON

By Special Correspondent

FORECASTERS began even before the end of March to tell Washington what bills would pass before Congress adjourns and which would fail. This annual game has its useful aspects but must not be taken too seriously. Even the best-informed officials, those who will formulate the program and steer the legislative craft in the Houses of Congress, admit that they cannot tell what is going to happen.

Even more silly seems the effort of some to say just when Congress will go home and leave American business again undisturbed by speech making and threatened enactments of wild ideas. Yet it is worth while to guess—one can do no more than that—as to whether this admittedly depressing influence on convalescent industry is soon to be eliminated. Those of longest experience and the best guessing records now indicate September as the time of adjournment. But one usually splendidly informed guesser is so definite as to say July 2. Perhaps this is on the theory that Congressmen will prefer to shoot their fireworks at home on Independence Day rather than continue pyrotechnics on Capitol Hill. The only sure thing is that the pyrotechnic display will continue in Washington throughout the summer.

Labor Promises

PRESIDENT ROOSEVELT paid heavily to secure the enactment of the work relief bill with substantially all of its basic features in line with his wishes. Of course, no one can say just how many Senators had to be persuaded by the reaching of "understandings" as to pet projects back home or Administration support for pending bills. But it is perfectly evident that the cost was high and that the President has exhausted much of his trading ammunition in this first major engagement.

Among the promises seemingly made is further support for the limited-hour week and for the Wagner labor-relations bill. One or both of these, or perhaps some compromise combination of them, is likely to be enacted. And the prospect this month is for much more drastic enactments than appeared likely even one month ago.

Possibly the most important consideration in determining the course of labor legislation will be the effect on public opinion of the promised strikes in coal, textiles, and other industries. Most of Washington believes that some of these strikes are being definitely formulated as a demonstration of the potency of the A. F. of L. in order that its embarrassment over the defeat of the prevailing-wage section of the work relief bill may be offset. A well-planned coal strike with a substantial number of miners held under control by the powerful John L. Lewis would probably be the most important action to be expected from this effort.

Extending NIRA

APRIL OPENS with Administration leaders of the Senate definitely pressing for reenactment of NIRA in order that NRA codes may be continued in force for both labor and trade practice regulation. It is evident, however, that a long and rocky road lies ahead for this fundamental measure. A considerable share of the controversy will presumably center around the question as to whether NRA is unduly encouraging monopolistic practices and working for large enterprises as against small.

If NRA is extended, especially the famous Section 7a, the pressure for the Wagner bill will be reduced materially. However, it must not be forgotten that the A. F. of L. desires the Wagner bill and some form of Section 7a as *permanent* legislation quite aside from the benefits which labor expects from continuance of NRA activity. It is this desire for greater permanence of labor protection that has in part occasioned the more than coolness of the Federation toward the "Blue Eagle" Act.

Mineral Policy

PROCEEDING from the philosophy of the distinctive character of the mineral industry there will be formulated during April and May the final report of the Planning Committee for Mineral Policy. The preliminary report of that agency has already appeared (see *E.&M.J.*, Jan., 1935, p. 4). The final report, expected for issue in midsummer, will amplify that early document and undertake to particularize commodity by commodity as to needs of each metal and important mineral which the Committee feels that it should discuss.

Quotas as a basis of control for minerals imported into the United States are gaining decided favor among mineral economists of the Capital. The trend to lowered tariffs, evidenced by Cuban, Brazilian, and other trade agreement announcements, indicates that larger imports are wanted by those dominant in federal policy making. But the difficulties currently encountered by potash, iodine, and other minerals make it evident that unrestricted import is too dangerous to be risked in the present unsettled condition of world currencies. As a matter of fact, it is the certainty of further wide fluctuation in exchange rates among important mineral trading nations that is strengthening the argument of those who think United States mineral imports must be quota-ized.

Imports of potash materials during the calendar year 1934 were 413,000 tons, barely 2 per cent above the previous calendar year, but 60 per cent higher than in 1932. Another large jump in imports occurred during last January, when there was imported more than twice the potash material brought in during January a year ago. This trend accentuates the argument favoring a quota on imports in order to protect this infant industry in America. Tariffs and production bonuses are objected to, of course, as prospectively increasing the price to users, primarily fertilizer makers, and ultimately the farmer. The argument sounds convincing; but for the present moment there is no evidence that it can achieve useful legislative status soon. It is expected, however, that the Planning Committee for Mineral Policy will discuss and perhaps make specific recommendations along these lines for this mineral and related minerals.

Mineral Patents Ruling

PRODUCTS produced by processes patented in the United States may be imported without violation of the patent law if there be no product patent in force. This is the substance of the decision of the United States Court of Customs and Patent Appeals permitting Amtorg to bring in from Russia apatite concentrated by a flotation process which it would not be entitled to use in this country. The court in this decision definitely reversed the findings of the United States Tariff Commission, which had recommended an embargo on the Russian product as a result of a joint complaint filed by Phosphate Recovery Corporation, American Cyanamid Company, and International Agricultural Corporation.

The Court decision also reverses what was previously understood to be the same Court's finding in the precedent-making Bakelite case. But lawyers now notice that in the Bakelite case there was a product patent which would have been adequate even under the present finding to prevent import of identical type of material from a country of origin that had not accorded a process patent to the American firms involved. In other words, the Court now makes a distinction not generally previously observed—namely, that the product patent is adequate to stop imports but the process patent is not.

Also pending at this time and not finally adjudicated is the case of Northern Pigment Company *et al,* involving oxide of iron pigments. Previously it has been held that this Canadian company and its affiliates should have their products embargoed from entry because the production was by manufacturing processes patented in the United States. Final decision in the pigment case is confidently expected by Washington to conform to the apatite decision.

Copper Agreement

WASHINGTON regards the international copper agreement reached March 28 as the most important forward step ever taken in the interest of this metal. Officials note with interest that the plan of control of production on the basis of the size of stocks, rather than by arbitrary price fixing, is a definite acceptance by this industry of the principles advocated in the preliminary report of the Planning Committee for Mineral Policy. In so far as that report represents official opinion —and it appears to have wide acceptance in Washington—the copper agreement seems assured of official aid and encouragement. This is a consideration of great importance just now, when such "deals" having monopolistic significance might otherwise come under an official cloud.

The promise of an organization to gather complete statistical information for the coordination of world stocks and prospective demand is also in line with the best official thinking in Washington. Mineral economists there hope that the Bureau of Mines may be accorded a like function with reference to domestic production, stocks, and needs. Serving in such fact-finding capacity, they argue, is a logical responsibility of the Bureau, which represents a most important confidential repository capable of quick action in such mineral-statistical matters.

Washington understands that the American quota for export, though not as large as some would like, is not handicapped by the need for absorbing re-exports of copper in fabricated products. This will, of course, assist those producers with cheap foreign sources of metal, since they will continue without hindrance to bring in their raw material for United States processing into manufactured products with the assurance of re-export on an extra-quota basis.

"Public Utility" Coal

ONE CANNOT safely reason as to metal and non-metallic mineral problems from the noisy effort being made to declare coal a public utility. Incidentally, most attorneys do not believe that any effort so to interpret the importance which unquestionably attaches to coal could bear legal scrutiny. The Supreme Court has said in other cases that mere declaration by a legislature that an industrial activity is of the nature of a public utility does not create this status for such industry. The status of the industry is, in the view of the Supreme Court, a matter of fact. And, seemingly, the Court would be disposed to say that only a natural monopoly, accorded rights like gas and electric enterprises freed from competition, could be legally held a public utility in fact. If this view prevails, Washington believes that some other method than the Guffey coal bill will have to be found for the coordinated, regulated, and protected development of the mineral industries.

Unquestionably there is throughout the Executive departments, and to a limited extent in Congress, the definite view that the major mineral industries must be accorded different supervision and some additional protection beyond that which is needed for manufacturing, merchandising, or other sorts of business activity. The distinction made is that mining of metals and non-metallics deals with exhaustible natural resources in which the public interest is substantial and that ruthless competition with wasteful development is so detrimental to the public as to permit, if not actually require, federal regulatory effort.

Uncle Sam, Miner

PROPOSALS that the Bureau of Mines have $100,000,000 to undertake active mining for precious metals and strategic minerals find a divided response in Washington. Proponents argue that this would greatly relieve unemployment in Western mining districts and reinforce supplies of precious metals and strategic materials which Uncle Sam needs. This group, of course, vigorously supports the Pope bill, which is intended to give aid to enterprises of this sort of the submarginal or marginal type.

Opponents call attention to several important objections other than the one that Uncle Sam has no right to be going into business in such a fashion. They point out that many projects which now have some sort of reputation could not safely be presented for consideration to the Government, since the resulting publication of the facts regarding these enterprises would permanently destroy their economic status. Thus it is argued that those who should be helped by such measure would actually be harmed.

The conservationists, of course, also oppose the idea of immediate mining of marginal supplies of strategic metals in this fashion, feeling that these resources are better left in the ground until real need or higher price makes production at least important, if not profitable. But the Government-in-business school of thought represented by many in high official position gives backing to the measure despite these criticisms. The Bureau of Mines, of course, must remain neutral, so far as publicity is concerned, although it is the most interested party involved.

Inflation

THE tremendous strength of the inflationists in the Senate was clearly evidenced in the attachment of the Thomas silver amendment to the work relief bill at the last minute, later eliminated by House conference action. The Senate result was accomplished despite a majority opposition, but the minority backing the measure was sufficiently powerful that it could have delayed enactment of the measure almost indefinitely if not appeased in this matter.

Other inflation measures seem to take a less important place in the legislative calendar. None of them may be actually enacted, but they represent at all times a threat against smooth legislative progress for other bills.

Increased Capacity Rating Granted Phelps Dodge

The National Industrial Recovery Board has conditionally granted the Phelps Dodge Corporation, which recently purchased the United Verde Copper Company, an increased productive capacity rating on a basis of its expansion and allowed the corporation to retain its former percentage monthly sales quota.

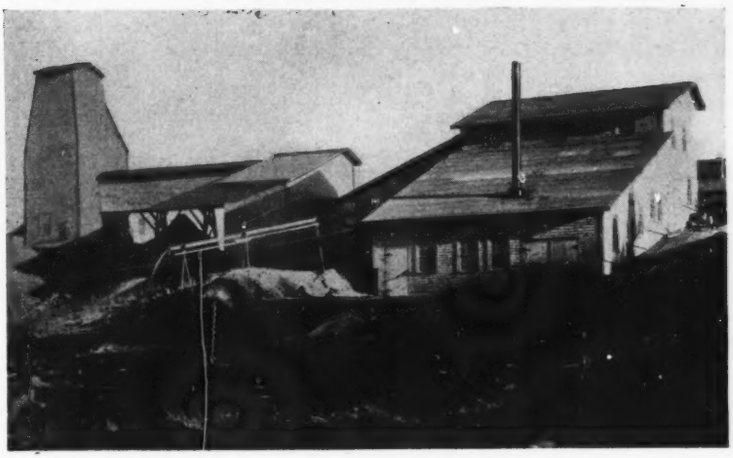
This increase was allowed pending the submission of an appropriate amendment to Section 6 (2) of Article VII of the Code, reallocating production and sales quotas. Suggestions or objections concerning such an amendment must be filed with Deputy Administrator W. A. Janssen, Room 605 Albee Building, Washington, D. C., before April 16, 1935.

The Phelps Dodge Corporation, in its application for an exemption from the present provisions of Section 6 (2), asked to be allowed a monthly sales quota of 1.67 per cent of a 236,000-ton annual productive capacity.

•

Knaben Mines Erects Plant

Reconstruction of the flotation plant at Knaben Mines, the Norwegian molybdenum producer, has been completed, and operations were started about Feb. 1. The old plant was destroyed by fire last year. All of the former crew, about 150 men, have been re-employed.



• Typical of the many small mills being installed in the gold districts of Canada is this 25-ton plant at the Lacey mine, Chester Basin, Nova Scotia. Equipment in the mill includes a 9x15-in. jaw crusher, a 4x3-ft. Marcy ball mill, a Gibson amalgamator, and Wilfley tables. Concentrate is being stored for shipment. The above reproduction is from a photograph taken by J. P. Messervey, Department of Public Works and Mines, Halifax, Nova Scotia

Canadian Taxes Impose No Hardship On Mine Operators or Shareholders

Minister of Finance Issues List of Thirteen Dividend-Paying Companies That Have Paid About $6,000,000 in Federal Taxes—Eight in Ontario Are All Gold Producers With the Exception of International Nickel

THAT the tax on dividend-paying gold mines imposed last year by the Canadian federal government has not worked a hardship on operators or shareholders is clearly evident from the following list of mines that had paid just short of $6,000,000 up to the end of January. This list of thirteen mines was made public by the Minister of Finance, the Hon. E. N. Rhodes, in answer to a member's question in the House of Commons: Consolidated Mining & Smelting Company (B. C.); Dome Mines (Ont.); Hollinger Consolidated Gold Mines (Ont.); International Nickel Company (Ont.); Lake Shore Mines (Ont.); McIntyre-Porcupine Mines (Ont.); Noranda Mines (Que.); Pioneer Gold Mines (B. C.); Premier Gold Mining Company (B. C.); Siscoe Gold Mines (Que.); Sylvanite Gold Mines (Ont.); Teck-Hughes Gold Mines (Ont.); Wright-Hargreaves Mines (Ont.). Of the eight companies in Ontario, only one, International Nickel, is outside the two large gold camps. Those in British Columbia and Quebec are similarly well established and highly profitable. Since the incidence of the federal tax, a number of other gold mines have commenced to pay dividends, but these pay no tax.

The federal bullion tax was imposed expressly as a temporary measure to get $10,000,000 from the extra profits resulting from the enhanced price of gold. It has now been superseded by a less direct tax calculated to return the same amount of money to the federal coffers. From June 1 next, the corporation tax on gold-mining companies will be altered in two respects: the depletion allowance will be reduced from 50 per cent to 33⅓ per cent, and the income tax will be raised from 12½ per cent to 13½ per cent. In addition, the depletion allowance to shareholders on their dividends will be reduced from 50 per cent to 20 per cent.

More serious, from the long-range point of view, is provincial taxation. Already the government of Quebec has announced its intention of increasing the royalty on metal mines. A substantial revenue was formerly derived from the royalty on asbestos in the days when the asbestos mines were prosperous. Today the asbestos mines are struggling, so the royalty has been abolished, the burden being shifted to the youthful and profitable metal mines.

ONTARIO

• The present dominating position of International Nickel in the world market for the platinum metal is indicated in the Ontario government's statement of production for 1934, practically all of which output came from the refineries of this company. Production totaled 200,109 oz. of platinum, palladium, osmiridium, and alloys of these metals with one another, and the company's annual statement shows 124,424 oz. sold. World consumption of platinum alone in 1934 is estimated at 200,000 oz. International Nickel's 1934 sales of gold and silver, similarly derived from the ore of the Frood mine, were 74,375 oz. and 1,006,808 oz. respectively. Combined value of the company's precious-metal output for the year was more than $8,500,000. This, as well as nickel and copper output, will be increased substantially during the current year.

Howey Gold Mines' record for 1934 shows 481,757 tons of ore (1,300 tons a day) milled for a recovery of $3.31 a ton, at an operating cost of $1.83 per ton. Adding 55c. per ton to this for taxes and depreciation, the net profit was 93c. per ton. With this profit and a part of its profit for the preceding year, the company paid 10 per cent dividends on its outstanding capital of $5,000,000. Ore reserves have been increased slightly to 2,155,000 tons having an estimated average value of $3.50 per ton, which is 18c. per ton less than the average gross value of the ore milled last year. As costs are expected to remain at their present level, a reduction of about 20 per cent in net profit is indicated, assuming that the price of gold continues as at present.

The hopes of the Swayze gold area now rest upon the chance, first of Haleron-Swayze obtaining more funds for exploration, and then of finding ore of higher grade wherewith to raise its present average to a profitable level. Development to 350 ft. and tests in a 25-ton mill indicate 35,000 tons of ore of $6 grade at the present price of gold. If the price of gold should rise to $41, the management estimates that enough additional ore would become available to insure the profitable operation of a 250-ton mill.

Diamond-drill holes to 500-ft. depth having given cores showing the same high-grade ore that characterizes the surface and subsurface of the vein, Sturgeon River Gold is preparing to install a mining plant. The development is being financed and managed by Coniagas Mines.

Macassa's average recovery from 50,000 tons of ore milled during the nine months ended Jan. 31 was $16.49 per ton, and total costs, with write-offs, was $9.86 per ton. The recovery is about the average for the Kirkland Lake camp, and the costs are somewhat higher.

The long crosscut being driven on the 100-ft. level from the Goldale shaft of Coniaurum southward into Central Porcupine ground has intersected a vein of workable width and grade 500 ft. within the Coniaurum boundary, in a section not heretofore known to be gold-bearing. This is of considerable

importance to McIntyre, whose boundary is within 400 ft. to the west, as well as to the other two companies. Central Porcupine holds a large area of ground to the south with geological features known to be favorable and is preparing to sink a shaft in a central location.

Central Patricia is doubling its mill capacity to 100 tons a day. The mine and mill are now electrically operated with power from the recently completed plant of the Ontario Hydro Electric Commission on the Albany River, which also supplies the Pickle-Crow mine.

Marbuan Gold Mines, operating the Porcupine property formerly known as March Gold, which proved unprofitable, has not yet duplicated the success achieved by its sponsors with Buffalo Ankerite. The latter had substantial deposits of ore formerly of marginal grade, and its present profit is measured roughly by the increase in the price of gold. Marbuan has not yet found similarly consistent deposits, but is seeking them at deeper levels down to 1,000 ft.

• Pouring gold bullion bars at the Trail plant of the Consolidated Mining & Smelting Company, in British Columbia, Canada. Recent gold production at Trail has been at the rate of about 3,000 oz. per month. Prospecting and development operations of the company have been extensive in northern Canada, with gold properties receiving preference in the investigations made by its examining engineers

QUEBEC

• Gold production of the area south and southeast of Amos is mounting steadily. Siscoe's output last year was $2,116,603 from 124,151 tons, an average of $17.04 per ton. The ore reserve is 280,000 tons of ore having an estimated average value of $15.56 per ton with gold at $35. Recent underground exploration has extended considerably the area of gold-bearing ground, both laterally and on the present lowest level at 1,350 ft. Sullivan's 50-ton mill turned out $32,600 from 1,816 tons in February, and the mine appears well able to supply the 50-ton additional capacity now being put in, with ore of about the same grade. Its newly discovered vein system is somewhat similar geologically to that of Siscoe and holds similar possibilities. Farther east in the Pascalis-Senneterre area the pioneer mine of the locality, the Bussieres, has so far failed to yield a consistent profit; but the Lamaque mine of Teck-Hughes, with similarly erratic deposits of ore, promises a good profit for the 225-ton mill now under construction. Tiblemont Island, Shawley, and Perron Gold, in the same area, are rapidly developing bodies of ore that promise to be profitable.

Beattie is making a handsome profit from its $6.50 ore, in spite of the fact that 30 per cent of the gold values remain in a concentrate that must be shipped abroad for treatment. The mill has been averaging 1,200 tons a day during recent months. The 2-ton test mill designed to try out the new process that may recover all the gold at the mine will be put in operation soon. Mine development on the 500-ft. and 1,000-ft. levels in deposits to the south and east has shown substantial amounts of ore, of about the average grade of the mine, and doubtless the milling capacity will be increased as soon as the company determines by what means the shipment of concentrate can be avoided and a full recovery of gold made at the mine.

The McWatters mill, in Rouyn, illustrates the comparative ease with which certain high-grade gold ores can be treated. The mill yield is about 1½ oz. per ton. A blanket concentrate is made, and this is re-concentrated on a Wilfley table and treated with mercury in a clean-up barrel. The tailing contains about $5 in gold, so a small cyanide plant is being installed to treat it. About 75 tons a day is being milled at present.

BRITISH COLUMBIA

• Not fewer than twelve new mills were constructed last year at gold mines in widely separated areas throughout British Columbia. Although one could scarcely expect that this record will be equaled during the present year, prospects nevertheless are that not only will additions be made to the number of existing mills but also in quite a few instances capacity of the latter will be considerably increased. During the past month directors of Gold Belt Mines, in the Sheep Creek area, definitely decided to proceed with the construction of a mill at that property; at the Relief Arlington, in the same camp, capacity of the mill is to be doubled to 80 tons forthwith by the addition of a ball mill and two flotation units. The new mill at the Queen mine, owned by Sheep Creek Gold Mines, is expected to be in operation next month; and the capacity of the Dentonia mill, in the Greenwood camp, will probably be stepped up to 135 tons daily in the near future. Should the developments in progress at depth on the Big Missouri property, in the Portland Canal district, prove conclusive, milling on a large scale, probably on the basis of from 1,000 to 1,500 tons a day, will probably be undertaken. The erection of mills at a number of small properties is also under consideration.

Development of the nickeliferous deposits near Hope is being watched with interest. The work is being undertaken on a large scale and is giving employment to about 150 men. At the recent annual meeting of the company in Vancouver, the directors reported that the presence and continuity of orebodies outlined by diamond-drill holes at present levels provide the basis for an estimate of probably 700,000 tons of "better than 1.25 per cent nickel ore, containing also other commercially profitable minerals including iron, sulphur, cobalt, and copper, with small values in precious metals." As development work is entering what is considered to be the best ground, crosscutting and diamond-drill work will, in the course of the next two or three months, indicate possibly thrice the above-mentioned tonnage. The report states that much preliminary consideration has been given to the mining and milling of the ore, and the company

has been advised by a metallurgical authority that the treatment will be relatively simple. As soon as the directors are satisfied that a minimum of 2,000,000 tons of nickel ore of better than 1 per cent has been made available, plans for mill construction will proceed. In the meanwhile the ore is to be conveyed by aërial tram a distance of 8 miles to the railway at Choate. The mine manager, C. B. North, estimated that a 1.25 per cent ore would be worth $7 per ton for nickel content, and that, in addition, both the cobalt and copper content would be marketable. Possibly the sulphur and iron may also be turned to profitable account. The ore carries about 14 per cent sulphur. In Mr. North's opinion 1.25 per cent nickel ore may be regarded as commercial and will afford a fair margin of profit.

In the Bridge River district production is being well maintained. In February the Bralorne company treated 11,658 tons, which yielded 3,782 oz. fine gold, and the value of the bullion produced from the Pioneer was $240,000. At the Bralorne, the main shaft is being sunk another 200 ft., hence a new level will be opened. In consequence of the discovery of a rich oreshoot on the Wayside, the directors, according to reports, have decided to proceed with the installation of a 100-ton cyanide mill.

In the Osoyoos district the old Nickel Plate mine, owned by Kelowna Exploration, is again in production, with the mill operating at three-quarters capacity, or at the rate of 150 tons a day. Expectations are that within two or three months the operation will be stepped up to full capacity.

An important discovery of high-grade ore over a width of 7½ ft. at depth on the Mak Siccar property, in the Fairview camp, is reported.

In the Cariboo district production from Island Mountain Mines in February was 1,170 oz. from 1,953 tons of ore. At the recent annual meeting of the company development to date on the property was reported to have disclosed nine veins, as well as the discovery of replacement deposits containing massive pyrite carrying considerable gold. Ore reserves, conservatively reckoned, were estimated to be 37,250 tons averaging 0.72 oz. in gold. Of this, 20,280 tons is in quartz veins averaging 3.9 ft. in width and 0.43 oz. of gold; and 15,970 tons in the sulphide replacement body averaging 4.16 ft. in width and 1.10 oz. in gold. On the dumps is 1,000 tons of rock having an average grade of 0.70 oz. Exploration at Cariboo Gold Quartz is proceeding with satisfactory results. The cross veins of the Saunders area have been opened for a distance of 1,000 ft. and at various levels, and the manager estimates that the developed reserves are sufficient to supply the mill for at least three or four years. Meanwhile the capacity of the mill will probably be increased from 100 to 200 tons a day. At the Quesnel Quartz development operations on a larger scale are planned for this season.

At the Premier, in the Stuart district, milling, which was suspended last November on account of the destruction of the power plant by fire, has been resumed.

According to general understanding the Granby company will discontinue operations at Anyox and dismantle the smelter there at the end of May or early in June, unless the price of copper advances to 8c. a pound. The suspension of this important operation will be a great loss to the Province, and recently representations have been made to the Provincial and Dominion governments suggesting that some action be taken with a view to indemnifying the company against loss providing it will consent to continue operations should the copper market not improve. Closing of the mine will affect a community of 2,500 people and will greatly aggravate the unemployment problem in British Columbia.

During the past month the Monarch mine, at Field, discontinued operations owing to the low prices of lead and zinc.

MANITOBA

• The 150-ton mill of Gods Lake Gold, the equipment for which is now at the property, is expected to be in operation next September, coincident with the 1,900-hp. hydro-electric power plant at Kanuchuan Rapids. The ore blocked out above the 275-ft. level is 63,000 tons averaging 0.52 oz., or 76,000 tons averaging 0.43 oz., allowing for 20 per cent dilution. This, with ore indicated beyond what is blocked out, will feed the mill for two years. Only a small part of the gold-bearing zone has been opened up to the present. The estimated operating cost is $7 per ton, exclusive of depreciation and taxes, indicating an operating profit of $6.74 per ton with gold at $34. The cost of hauling supplies from the railway is $30 per ton, and as 20 lb. of materials is required per ton of ore treated, the long distance from the railway will impose a charge of only 30c. per ton. This 30c. thus measures the additional cost of operating a gold mine in northern Canada at a distance overland of 120 miles from the railway, the low figure being attributable to the effectiveness of tractor trains on the level winter roads.

San Antonio milled last year 64,294 tons of ore averaging 36 oz., the recovery being $11.78 per ton. The operating cost was $5.42 per ton and the net profit $4.60 per ton. Ore reserves at the end of the year were 225,000 tons averaging 0.39 oz. The favorable ore developments that led to the mill enlargement and sinking of the new 1,000-ft. shaft last year are continuing.

•

Gold Mine Worked by Romans Reopened in Great Britain

Roman Deep Holdings is the name of a new company that has been formed to reopen a gold mine in Great Britain which is said to have been worked extensively by the Romans. A report states that the Romans left about 1,000,000 tons of tailing, assays of which "show values up to four pennyweights." The property is in South Wales, near Lampeter. Funds have been subscribed privately to unwater the old mine and test the ore at depth.

Novo Brdo Mines Encounters Substantial Deposit of Ore

Novo Brdo Mines, exploring a property in Serbia, Yugoslavia, which, according to historical records, was one of the most important sources of silver production in the Middle Ages, has encountered what appears to be a substantial deposit of ore, its extension having been found in a second crosscut. The first 7 meters in crosscut No. 102 is reported to have assayed 6 per cent lead, 14 per cent zinc and 4.31 oz. of silver and 2.20 grams of gold per metric ton.

•

Question of Burma Corporation's Productive Life Again Raised

The question of the remaining productive life of the Burma Corporation's mines was raised again at the recent annual meeting. Mineralization does not apparently go down into the Yunnan sediments which were encountered at the No. 10 level in the Chinaman and Shan sections. A long connection on the No. 12 level from the Chinaman to the Meingtha section found only the same unfavorable Yunnan sediments. Much difficulty has been experienced in diamond drilling, but that the unfavorable condition persists for at least 400 ft. below the 14th level has been finally ascertained. Some ground of possible value remains to be explored, however, and the company has more than 4,000,000 tons of ore in reserve, which is sufficient to prolong operations for at least nine years at the present rate of extraction. In addition, a belief prevails that a considerable tonnage remains to be developed, and that a large tonnage of lower-grade ore exists which metal prices may some day make valuable.

Gold in the Fiji Islands Holds Interest of the Australians

Important Mineral Area Developed Six Miles South of Tavua, on the Island of Vitu Levu—Koroere Gold Mines Is Operating a 50-Ton Cyanide Plant—Formation of a Number of New Companies Expected

THE MOST outstanding development in Australian gold-mining circles during recent months has been the transfer of interest from Western Australia to Fiji. On the island of Vitu Levu, one of the Fiji group, an important gold area has been discovered 6 miles south of Tavua. The Emperor lode, on the northern part of the field, has been tested over a length of 900 ft. and to a depth of 100 ft., with the result that a large tonnage assaying more than 15 dwt. has been proved over a width of 20 to 70 ft. The lode dips steeply to the east and strikes northwesterly. A cyanide plant with a capacity of 50 tons per 24 hours is in operation. This property is being worked by Koroere Gold Mines.

The extension of the Emperor lode to the south is being tested by Koroere Gold Mining, a recently formed company. Other lodes, as yet undeveloped, are known to occur in the southern area. To the west of the Emperor lease, Loloma Gold Mines has been formed to test the Loloma lode. This has been proved for 1,600 ft. and over a surface width of 10 ft. Sulphide ore occurs in a creek traversing the lode formation. Other areas in the vicinity of those mentioned are being tested, and a number of additional operating companies will probably be formed. The lodes on the Tavua field occur in altered andesite. Dolerite and basalt are found on the west, and on the east, mudstone and slates. Behavior of the lodes with depth will be watched with great interest.

This month the aërial geological and geophysical survey of northern parts of Australia will commence. Aërial photographs will first be taken, and then geologists will inspect unusual changes in surface rocks and contour as indicated in the photographs. Geophysical surveys will follow where warranted. The cost of this investigation is estimated at £150,000 over three years. The Commonwealth Government will contribute half this amount, the governments of Western Australia and Queensland sharing the remainder. Hopes are expressed that this survey, which is under the executive control of Sir Herbert Gepp and directed by P. B. Nye, formerly Government Geologist of Tasmania, will result in new finds.

• • •

WESTERN AUSTRALIA

• The erection of a treatment plant at the Lancefield mine, at Laverton, has been completed. Treatment comprises fine-grinding, flotation, roasting of concentrate, cyanidation, and precipitation of gold in a Merrill-Crowe unit. Capacity of the plant will be 12,000 tons monthly of ore, of which at least 300,000 tons is available. A dump of 1,000,000 tons has been tested, and this can be treated profitably.

Insufficient work has as yet been done on the new gold field at Yellowdine to establish the geological character of the orebodies and to give information as to their probable behavior at depth. The steeply dipping reefs occur in sheared greenstone and strike north and south. At least 30,000 tons assaying 2 oz. of gold per ton has been proved to a depth of 44 ft. A number of companies are operating, and full information should soon be available.

Australian Mining Trust is forming a company to develop and equip the Celebration gold mine, at Hampton Plains, 25 miles south of Kalgoorlie. About 60,000 tons of ore has been proved to the No. 4 level. On the No. 1 level the lode has been proved for 1,000 ft., and a diamond-drill hole has penetrated a second lode, which is being opened up by crosscutting. A fine-grinding cyanidation plant is being installed to treat 4,000 tons monthly.

Gold Mines of Kalgoorlie has been formed in London by Gold Exploration & Finance. Two other subsidiary companies are to be formed. Gold Exploration & Finance holds 1,000 acres at the southern end of the Kalgoorlie field.

TASMANIA

• Briseis Consolidated has been formed by Burma Malay Tin to reopen the Briseis deep-alluvial tin mine at Derby. The capital of the new company is £150,000. Between 1899 and 1929—the workings were flooded in 1929—the company formerly operating the property recovered 13,939 tons of tin concentrate and paid £517,000 in dividends. At least 4,500 tons of tin oxide is said to be still available for extraction. Reclamation of the mine to the production stage is estimated to involve a cost of £68,500 and to require two years.

Mount Bischoff Tin Mining, at Waratah, which is operated by tributors, made a profit of £9,410 for the year ended Dec. 31, 1934, or £2,000 more than in the year previous. The mill treated 19,651 tons of ore and 9,108 tons of tailing, recovering 338 tons of tin oxide. In addition, 24,080 cu.yd. of alluvial was sluiced, for a recovery of 23 tons of tin oxide. Indications are that Mount Bischoff will continue to be a steady producer for some years.

Electrolytic Zinc, at Risdon, has decided to place in operation its fourth unit of electrolytic cells, bringing current output to the rate of 70,000 tons of zinc per annum, or 16,000 tons more than at present. This new unit was completed several years ago, but marketing conditions did not justify placing it in operation. No immediate prospect exists of the West Coast mines starting up.

NEW ZEALAND

• The dredge being erected by Bundi Tin Dredging at Greymouth will be in operation this month. Of the total lease of 473 acres, 76.8 acres is said to contain 2,955,000 cu.yd. with 4.5 grains of gold per cubic yard. The plant will dig 120,000 cu.yd. monthly.

The yield of gold in New Zealand for 1934 is not expected to show any appreciable alteration from the record for 1933, when the output was 161,755 fine ounces. During 1934 the Waihi company, which has been in operation for nearly 50 years, treated 229,351 short tons, recovering 63,335 fine ounces of gold and 359,629 oz. of silver.

QUEENSLAND

• The steam power plant at Mount Isa is generating electricity at the low cost of 0.313d. per kilowatt-hour. Equipment in use consists of two Babcock & Wilcox marine-type water-tube boilers, each of 8,160 sq.ft. heating surface, which are operated at a pressure of 300 lb. per square inch. The boilers are fired with pulverized coal; coarse coal costs 39s. per ton delivered at Mount Isa. Coal consumption is 9.2 lb. per kilowatt-hour, and 9.24 lb. of steam is produced per pound of coal.

CENTRAL AUSTRALIA

• Milling at the Golden Dyke mine, at Shackle, has commenced. The plant, which embodies fine grinding and cyanidation, has a capacity of 100 tons daily. More than 130,000 tons, assaying 8 dwt. gold per ton, is said to have been proved to the 100-ft. level.

PERSONAL ITEMS

A. H. Krynauw is general manager of East Rand Proprietary.

P. K. Horner sailed from England recently for the United States.

E. C. J. Meyer has become general manager of New Modderfontein.

Alberto Terrones Benitez has opened an office at Calle Tacuba 92, Mexico City, Mexico.

E. E. Cooley, mining engineer, has moved from Hermosillo, Sonora, to Nogales, Ariz.

B. T. Altson, assistant manager of City Deep, has been appointed general manager of that property.

W. Reid, sectional manager of Crown Mines, has become manager of the Durban Roodepoort property.

C. M. Bowyer has been appointed manager of Sturgeon River Gold Mines, in northwestern Ontario.

A. C. Burnett, formerly with Hawley & Hawley, of Douglas, has opened an assay office at Blackhawk, Colo.

A. H. Koen has changed his address from Tonkin, French Indo-China, to 36 Boulevard St. Michel, Paris, France.

H. Houghton Lauer, consulting engineer, has opened an office in the Law and Finance Building, Pittsburgh, Pa.

F. R. Weekes and **E. P. Crawford** have returned to San Francisco from a visit to their Yankee Girl gold mine, at Ymir, B. C.

Charles Hardy, president of Charles Hardy, Inc., New York City, sailed for Europe on March 30. He will be abroad six weeks.

H. C. Parmelee, Editorial Director of *Engineering and Mining Journal,* has returned to New York after a two weeks' visit to Colorado.

A. J. Walton has become consulting engineer to the Central Mining & Investment Corporation, succeeding the late **J. E. Healey.**

Donald S. Doyle, of the Selection Trust group of engineers, has returned to London from an extended professional visit to Venezuela.

J. C. Stroup, metallurgical engineer, of San Francisco, sailed for Manila, P. I., March 22, to become mill superintendent of Salacot Mining Company.

John Redington, manager of Coniaurum mine, at Schumacher, Ontario, has made a record for northern Canada by driving a crosscut slightly over 600 ft. in one month.

Donald Yates has succeeded **O. H. Woodward** as general superintendent of Broken Hill Associated Smelters, Port Pirie. Mr. Yates was formerly assistant superintendent.

L. A. Wescott, formerly superintendent of Mount Coolon Gold Mines, Ltd., has been appointed supervisor of the field activities of Western Mining Corporation in Western Australia.

Dr. C. E. Swartz has severed his connection with the American Smelting & Refining Company to accept a position with the Cleveland Graphite Bronze Company, of Cleveland, Ohio.

Byron B. Morton, formerly plant metallurgist at the Baton Rouge refinery of the Standard Oil Company of Louisiana, has joined the staff of The International Nickel Company, Inc.

Dr. L. W. Eastwood, assistant professor of metallurgy at Michigan Tech, has resigned to take a position in the research laboratory of the Aluminum Company of America, in Cleveland, Ohio.

D. L. Forrester, former mill superintendent for Old Dominion, recently operating a custom mill at Salome, Ariz., has accepted a position as metallurgist with Southwestern Engineering, of Los Angeles.

Dr. R. B. Young has become consulting geologist for the Far East Rand Areas Company. He resigned from the chair of geology of the University of the Witwatersrand to assume his present position.

Ellis Davies, chief engineer of Charles Ruwolt Proprietary, Ltd., manufacturers of mining and milling equipment, left Australia at the middle of February on a business visit to Great Britain and the United States.

R. V. Neily, mine superintendent at Buffalo Ankerite Gold Mines, Ltd., South Porcupine, Ont., since June, 1932, severed his connection with that company on March 1. He will reside at Schumacher, Ont.

Dr. Donald H. McLaughlin, of Harvard University, arrived in Australia at the end of February to confer with the geological staffs of Bendigo Mines, Ltd., Gold Mines of Australia, Ltd., and associated companies.

Norman L. Wimmler, consulting engineer, has returned to San Francisco, from a professional trip to Idaho and Oregon. Mr. Wimmler has recently opened an office at 74 New Montgomery St., San Francisco.

Sir Frederick Banting, discoverer of insulin, and still in the research department of the University of Toronto, is to direct the expenditure of a $20,000 grant made by the Ontario Mining Association for research on silicosis.

A. C. Nebeker, of Prescott, Ariz., has been inspecting mining properties in New Mexico and Colorado for Oklahoma interests who have taken an option on the Bonney Mine and Mountain Lilly, for detailed sampling and testing.

Charles V. Harris has resigned his position as junior assayer in the United States Assay Office in New York to accept a position as junior metallurgist with the South American Development Company, with mines at Zaruma, in the Province of El Oro, in the Republic of Ecuador.

Peter A. Cona has been engaged in gold placer prospecting for the last two years in several parts of Colombia. He has returned to that country with a Keystone drill to carry on work there in the Department of Caldas. This is being done for the account of a New York financial house.

C. B. Andrews, sales manager, Taylor-Wharton Iron & Steel Company, High Bridge, N. J., who recently returned from a trip to the tin-dredging areas in Siam, Federated Malay States, and the Dutch East Indies, was a recent visitor in San Francisco.

G. W. Prince, onetime assistant manager of United Verde Extension, has transferred from Davis-Dunkirk Mines to Hillside Mines of the same interests. Another addition to the Hillside staff is **Walter Black,** formerly manager of a mining property in Idaho.

Patrick Meehan, a miner at the Central Manitoba mine, is the first recipient of the Institute Medal for Bravery, which is to be awarded annually by the Canadian Institute of Mining and Metallurgy in recognition of signal acts of heroism.

Colin A. Campbell, the only mining engineer among the members of the Canadian Parliament, has recently been pressing a movement for the removal of customs duties on mining machinery, as a means of stimulating mineral production in the Dominion.

Richard W. Senger, general superintendent of the Garfield plant of the American Smelting & Refining Company, left Los Angeles by airplane on March 11 for Chile. Mr. Senger will be in Chile on company business for a month and will return by airplane via New York about May 1.

A. H. Miller, general manager of the Compañia Huanchaca de Bolivia, Pulacayo, Bolivia, has been made general manager of mines of Mauricio Hochschild & Company, Ltd., with head offices in La Paz, Bolivia. **John W. Shotwell,** formerly mine superintendent, has been promoted to the post of general manager of Huanchaca.

Gerald G. Dobbs has been appointed assistant general manager of Gold Coast Selection Trust. He left England on March 27 for the Gold Coast Colony, West Africa. Mr. Dobbs will also act for some months as general manager for Ariston Gold Mines, Ltd., until the present general manager, **G. H. Plowman,** who is ill in England, can resume his duties.

J. Owen Ambler has accepted an extension of a year to his contract with Rio Tinto, during which time he will be in charge of the company's smelting operations and will supervise design and installation of a melting and fire-refining plant for precipitate copper at the company's property in Spain. His address will be Rio Tinto Company, Ltd., 3 Lombard St., London E.C. 3, England.

R. K. Stockwell is on a trip in the West of China visiting the mining districts of Honan and Shensi provinces. For the next few months his forwarding address will be care of The Shanghai Club, Shanghai. His designs are completed for the new railway terminal port at Lian Yuen, in the north of Kiangsu Province, for the Chinese Government Ministry of Railways, and construction work is proceeding rapidly.

Ralph M. Roosevelt has resigned as vice-president and manager of the New York office of the Eagle-Picher Lead Company. Mr. Roosevelt joined the staff of the company in 1919, when Eagle-Picher took over the Lanyon Smelting Company, of Pittsburg, Kan. He plans to devote all his time, for the present, to the affairs of the American Zinc Institute, Inc., of which he is president.

William Joseph Hamilton

An Appreciation by

E. P. Mathewson

William Joseph Hamilton was born in Montreal, Canada, Dec. 2, 1862. He came of good Irish stock. He died at the Royal Victoria Hospital in Montreal on March 9, 1935. He grew to manhood in his native city and graduated from McGill University with the degree of Bachelor of Science in 1888. We were playmates as children. Will took up football early in his career and at college was star rugby player of the team. Although at that time he could not have weighed much over 120 pounds, he would not hesitate to tackle the heaviest opponent and bring him down. He was also adept at other athletic sports, particularly boxing and single stick.

On leaving college, he came to that famous training place for non-ferrous metallurgists, the Pueblo Smelting & Refining Company, of Pueblo, Colo., where he remained until 1897, when he transferred to the M. Guggenheim Sons Philadelphia smelter, in Pueblo also. Here he was assistant to Mr. August Raht, a very prominent metallurgist of his day and a graduate of Freiburg Academy.

In 1898 he was transferred to the smelter belonging to the same company at Monterrey, Mexico, where he acted as assistant to the writer and his immediate successor at that plant. He was later transferred to the Aguascalientes plant. When M. Guggenheim Sons joined the American Smelting & Refining Company and took control of same, Mr. Hamilton was made metallurgical manager of the company's smelters in Mexico. He held that position until the year 1911, when he left the employ of A.S.& R. to become general superintendent of the Cerro de Pasco Mining Company in Peru. The following year he was promoted to general manager. He retired in 1919, but returned to Peru in 1920 to build the new smelter at La Oroya for the same company. He again retired in 1923 and made his home in Westmount, a separate municipality surrounded by the city of Montreal. He was retained up to the time of his death as consulting metallurgist by the Cerro de Pasco company.

Mr. Hamilton was an excellent companion, had a good sense of humor, was tried and true as a friend, a faithful employee, and in every way a most likable and competent man. He married Iva Wright on Jan. 22, 1900. He leaves a widow and three children, Frederick Wright, Margaret (Mrs. Geoffrey Morkill, of Lima, Peru) and Dorothea, of Westmount, and three grandchildren, Frank, Anne, and Geoffrey Hamilton Morkill.

He came of a large family, of whom three brothers, Edward H., Arthur, and Ernest S., and three sisters, Mrs. R. W. Fowler, Mrs. J. W. Fowler, and Mrs. A. W. Bishop, as well as several nieces and nephews, survive.

OBITUARY

Dr. James Malcolm MacLaren, an internationally known mining engineer, died in Cornwall on March 19. His contributions to the mining industries included work in Alaska, Bolivia, California, Nevada, Mexico, Korea, the Sudan, Persia, and North Africa.

D. B. McDonald, of Duluth, age 75, died at Clearwater, Fla., on March 12. He was president and one of the founders of Cole & McDonald Exploration Company, which did extensive drilling on the Mesabi range during the early days of development.

George Young, of Tucson, Ariz., died on March 1 while on a business trip to Cananea, Sonora, Mexico. Mr. Young had made his home in Tucson for the past nine years, coming from Cananea, where he had served the Cananea Consolidated Copper Company as secretary-treasurer for more than twenty years.

Arthur Joseph Hoskin, noted mining engineer, college professor, editor, and author, died at Boulder, Colo., on March 13. He was 66. Mr. Hoskin, who went to Boulder from Chicago last September, had been managing the Bozant mine, in Central City. Born in Wisconsin, he was graduated from the state university in 1890 and began his career as a mining engineer at Idaho Springs the same year. In 1905 he received his master's degree in mechanical engineering from the University of Wisconsin and became an assistant professor at the Colorado School of Mines, holding the position until 1911. During his professorship at Golden he was editor of the *Mining and Metallurgical Journal* and later served as Western editor of *Mines and Minerals.* He became editor of the *Mining American,* published in 1917. Mr. Hoskin was a member of the American Institute of Mining Engineers, the Colorado Scientific Society, and the Masonic fraternity.

William J. Palmer, president of the Amalgamated Pioche Mines & Smelters Corporation, died in Bronxville, N. Y., on March 11. He was 76 years old.

William Joseph Hamilton, consulting metallurgist to the Cerro de Pasco Copper Corporation of New York and Peru, died in Montreal on March 9. He was 72 years old.

Prof. Henry Nellis Thomson died on Feb. 27 in Vancouver, B. C. He graduated from McGill University, Montreal, in 1897. He was chemist and assayer at the Trail Smelter until 1902. For seven years he was in charge of research work and chief chemist with the Anaconda smelter in Montana, where he became assistant superintendent. Later he became superintendent of the International smelter at Tooele, Utah, and from 1914 to 1917 was chief metallurgist with the United Verde company at Clarkdale, Ariz. Professor Thomson practiced as consulting metallurgist in Los Angeles from 1917 to 1919, when he accepted the chair of metallurgy at the University of British Columbia, in Vancouver, Canada, which he occupied until his death. He was a member of the American Institute of Mining and Metallurgical Engineers, the American Institute of Chemical Engineers, the American Chemical Society, the Society of Chemical Industry, the American Association for the Advancement of Science and the Institute of Metals in England and the Canadian Institute of Mining and Metallurgy.

Lamartine C. Trent, internationally known mining engineer, died on March 9, at his home in Auburn, Calif., at the age of 86. Born in London, England, in 1848, he first came to the United States on a sailing vessel as a boy of eleven years and made his own way here, fighting through the last year of the Civil War in the Union forces. His first mining experience was gained in the rich copper mines around Lake Superior. From there he went to Montana and Colorado, where he became closely associated with the late W. A. Clark and other prominent figures in the development of the Anaconda and other large properties. Later he established his own mining and machinery business and was sent as mining expert by the Japanese Government to Japan in 1889 to examine mining properties in the interior of the country, traveling there for eight months in places where no white man had been before. In 1900-02 he was sent to Australia and Tasmania as general manager of the North Mount Lyell Copper Company on the west coast of Tasmania. Mr. Trent's later years were passed in California, where he developed the Dairy Farm Mine, at Vantrent, which he sold to the Guggenheim interests.

Mr. Trent carried to the end of his full and useful life a rocklike integrity of character, sturdy independence of spirit, and loving kindness of heart that endeared him to all with whom he was associated both in private and professional life.

A Further Correction

The Editor:

We would like to make a few minor corrections as to Dome practice in the article by M. W. von Bernewitz on "Corduroy as a Gold Saver," in your February issue. The slope of our corduroy blanket tables is 1⅛ in. per foot. We use three strips of corduroy per table—not four. We change and wash all our corduroy blankets five times in eight hours—not merely the top strip, as stated. Our experience here leads us to believe that very frequent changes of the blankets are absolutely essential to the successful operation of these blankets in our mill. Once the surfaces of these blankets are allowed to silt up, their effectiveness as a gold trap is gone.

DOME MINES, LTD.,
J. H. Stoval, Assistant General Manager.

NEW BOOKS

Wants Still Unsatisfied

AMERICA'S CAPACITY TO CONSUME. *By Maurice Leven, Harold G. Moulton, and Clark Warburton. Washington, D. C. The Brookings Institution. Pp. 265. Price $3.*

This book is the second volume of a larger study which is concerned with the relation of the distribution of national wealth and income to economic progress. In the initial volume of the series The Brookings Institution undertook an investigation of "America's Capacity to Produce." (See *Engineering and Mining Journal,* October, 1934, p. 474.) This second volume consists of a detailed study of the sources, distribution, and disposition of our national income.

In contrast to the normal condition of excess productive capacity which the earlier work found to exist in American industry, the present study reveals a considerable lack of satisfaction of basic wants among the masses of our people. In fact, the authors of the book conclude that if in 1929 those family incomes which were less than $2,500—and even in such a prosperous year as 1929 this included the incomes of 70 per cent of all American families—had been raised to the $2,500 level, the expenditures of these families for food would have increased by 40 per cent, for shelter and home maintenance by 65 per cent, for attire and adornment by 65 per cent, and for other consumers' goods and services by 115 per cent. From the numerical results of this and the preceding study, it is also concluded that the present productive capacity of our country, even if fully utilized, would fall far short of fully satisfying the consumptive desires of the people. The corollary follows that any material shortening of the working day below the standards of 1929 would be incompatible with the production of the goods and services which the masses desire to consume.

That part of the book which relates to the trend of savings is of particular importance to the larger study which The Brookings Institution is making. Two of the authors are of the opinion that during the last three decades there has been a definite increase in the percentage of our national income which has been saved. If this is true, the contention of some economists that the cause of the great debacle of 1929 was "over-saving" or "under-consumption" might appear to have some weight. The third of the authors, however, feels that this conclusion is not adequately supported by the data presented. Further study on this point appears to be necessary.

The material of this book is ably presented and is well illustrated by charts. To all who are interested in the social and economic status of our people, it is recommended as an excellent bit of reading.

ACHESON J. DUNCAN.

• • •

A New Industrial Analysis

CAPITALISM CARRIES ON. *By Walter B. Pitkin. Whittlesey House, McGraw-Hill Book Company, Inc., New York. Pp. 282. Price $1.75.*

The indefatigable Mr. Pitkin in this work proffers *his* analysis of the world's economic maladjustments: a diagnosis and the indicated procedure. That he knows how to write and is himself vitally a part of his generation and its activities and interests will be news to no one. Pungently and wittily be unmasks and attacks the regiments and divisions of pessimism and despair that have for years been in full retreat from reality. He abhors, as his readers should, that smug and pragmatic didacticism that finds its roots in slogans and aphorisms. This is a public service. More than a century ago Honoré de Balzac made his Country Doctor say: "Competition is the life of trade." No one ever accused Balzac of being an economist, but the notion seems to have poisoned most thinking on the subject of economics ever since. More often than not, competition is the *death* of trade, business, industry—and nations. It may be—often is—a social blight.

Mr. Pitkin's publishers declare on the jacket of this his latest book:

"Mr. Pitkin brings together ample evidence to show that the possibilities of profit-linked-with-service and individual initiative are today greater than ever before in history. He points out that an immense amount of pioneering remains to be done in the fields of the low-cost production of goods, new aids and comforts for people, and the rendering of services. Capitalism depends on the stability of the middle class, just as the stability of the middle class depends on capitalism. Unlike the Marxians, however, Mr. Pitkin does not despise this middle class; rather does he look upon it as the hope of humanity. He sees the middle class today being ground to dust between the upper millstone of the Desperate Rich and the nether millstone of the Desperate Poor. If the Desperate Rich win out, then America goes Fascist. If the Desperate Poor win out, America goes Communist.

"The leaders of the future will be bold, resourceful, and intelligent middle-class men who are willing to venture into new and untried fields, assuming considerable risks in order to earn the rewards of commensurate profits. The first steps in the reconstruction of capitalism are already being taken, Mr. Pitkin believes. After five years of drifting and panic, capitalism has finally gained insight and courage to strike out along new lines. Public sentiment is behind such a program. It cannot fail, if executed with clear, bold minds. In sharp antithesis to the Socialist writers, Mr. Pitkin shows that there are many useful and profitable enterprises remaining to be undertaken by privately financed individual initiative.

"This is the author's most fully documented, thoughtful contribution to the solution of our contemporary problems. It should be read by every person who feels concerned about the future of America."

The foregoing is a good résumé of the work, which is well worth the study of all who wish to keep informed respecting the changes taking place in this age and to make, so far as may be practicable, a personal cooperative effort toward the evolution of a more just and stable social order.

W. N. P. REED.

National Self-Sufficiency

THE STRATEGY OF RAW MATERIALS. *By Brooks Emeny. Published under the Auspices of the Bureau of International research of Harvard University and Radcliffe College. The Macmillan Company, New York. Price $3.*

This book, the basic material of which was presented for the degree of Doctor of Philosophy at Yale University, comprises a unit in a series of studies on national and international types of control over basic industries and commodities that the Bureau of International Research of Harvard University and Radcliffe College has undertaken. The purpose of this study, as set forth by the author in his introduction, is to present the factual material necessary for the clarification of the three following questions: (1) Granted an extreme war emergency, to what extent could the United States, on the basis of its own resources, meet the full demands of self-sufficiency in the essential foodstuffs and industrial raw materials? (2) In the instances of the specific commodities for which we would be entirely or partly dependent upon imports, what sources of supply might be available from foreign countries under various contingencies of war? (3) What specific measures, if

any, could be adopted as a means of assuring our self-sufficiency under any war emergency?

In the opening chapter a comparison is made of the seven Great Powers, as to their degree of self-sufficiency and the size of their consumption demands in the essential foodstuffs and industrial raw materials. Differentiation between the more and less favored of the group is indicated, and their actual and potential industrial development rated. With a general classification of the Powers thus established, the author proceeds in the following chapters to analyze the strategic raw material situation in the United States. In the second chapter a broad survey is made of the world position of the United States in the important foodstuffs and industrial raw materials, as illustrated by the averages of our normal domestic production, exports, and the geographic origin of our imports in each commodity. A composite picture is thus presented of the extent of our dependence on foreign sources of supply, particularly in those commodities which offer a more or less serious strategic problem in procurement, under a war emergency. The remaining chapters of the book are devoted to a detailed analysis of the procurement problem arising in the instance of each strategic commodity indicated in the second chapter. Probable war contingencies and situations are presented for each of these commodities, and recommendations of measures necessary to assure an adequate supply for munitions and civilian needs under an extreme emergency are considered in each instance.

Undoubtedly, not every one will agree, in each instance, with the conclusions reached by Dr. Emeny. Also, the extensive data that he presents are, of course, susceptible to varying interpretation. But, as W. Y. Elliott, of the Bureau, points out in his preface to the book, no student who is interested in an accurate presentation of the complex facts upon which any procurement policy for national defense must rest can disregard this competent study. Comprehensive footnote references, a classified bibliography, well-prepared index, and, particularly, an excellent series of charts and "mineral-flow" maps, together comprise, perhaps, the outstanding feature of the book.

Steel "Timbering"

STRECKENAUSBAU MIT STAHL. *By Rudolf Würker. Verlag von Wilhelm Ernst & Sohn, Berlin. Price, 5.60 Rm. Pp. 82.*

During recent years much effort has been made to increase safety and reduce cost and upkeep by the use of steel instead of wood and concrete in drift sets. In this little volume the author discusses rock pressures, materials, and fundamental methods of construction, mainly in connection with German mines.

MINING YEAR BOOK, 1935. *Compiled by Walter E. Skinner, 15 Dowgate Hill, London, E.C.4. Pp. 884. Price 20s. net. Post free, abroad 21s. 6d.*

This is the 49th consecutive annual issue of the "Red Book of Mines." It contains particulars of 1,400 active mining companies throughout the world, including 220 new companies registered during 1934. Statistical tables cover the world's gold output. There are also lists of directors, mining and consulting engineers, mine managers and agents, relating to the companies described in the book.

CANADIAN MINES HANDBOOK, 1935. *The Northern Miner Press, Ltd., Toronto, Ont., Canada. Pp. 352. Price $1.*

Essential data on 3,584 mining operations in Canada are given in this new volume, reflecting an increase of about 40 per cent in mining activity since the last handbook was issued. Leading mining companies on the active list are analyzed in great detail, and a separate section is devoted to dormant or defunct organizations. The book is a valuable guide to all who are interested in Canadian mines and mining.

AN ENGLISH-RUSSIAN MINING AND METALLURGICAL GLOSSARY. *By N. I. Trushkoff. Published by the State Technical Theoretical Publishing House, Moscow, 1934. Pp. 255.*

Mr. Trushkoff, who is professor of mining at the Leningrad Mining Institute and the Moscow Institute of Colored Metals, and a member of the A.I.M.E., has prepared a handbook glossary which gives, first, mining and metallurgical terms in English, followed by the Russian equivalents. The volume should be of great value to mining men, geologists, and millmen on professional service in the U.S.S.R.

Publications Received

Geology and Ore Deposits of the Breckenridge Mining District, Colorado. By T. S. Lovering. Professional Paper 176, U. S. Geological Survey. Sold by Superintendent of Documents, U. S. Government Printing Office, Washington. Price $1.

Geology and Mineral Deposits of California, Bibliography to Dec. 31, 1930. By Dr. Solon Shedd. Bulletin 104, California State Division of Mines. San Francisco, Calif. Price $2.15, including shipping.

Mining Industry of Idaho, 1934. Thirty-sixth annual report of the Inspector of Mines, Boise. Pp. 287.

Geology of the Pearl-Horseshoe Bend Gold Belt, Idaho. By A. L. Anderson. Pamphlet 41, Idaho Bureau of Mines and Geology, Moscow, Idaho. Pp. 36.

Compilacion de los Estudios Geologicos Oficiales en Colombia—1917 to 1933. Vol. 2. (Geological Studies Made by Dr. Otto Stutzer and Ing. Ernst A. Scheibe, Department of Mines and Petroleum, Bogota, Colombia). Pp. 425.

Das Rapakiwirandgebeit der Gegend von Lappeenranta (Willemstrand). By Victor Hackman. Bulletin of the Geological Commission of Finland. No. 106. Helsingfors. Pp. 88.

Addresses of British Columbia Mines. List published by British Columbia Chamber of Mines, Victoria, B. C. Mimeographed. Pp. 12.

Newfoundland Gold Prospects. Information Circular No. 1, Geological Section, Department of Natural Resources, St. John's, Newfoundland. A. K. Snelgrove, Government Geologist, and C. K. Howse, Assistant Government Geologist. Pp. 16, one map. Assay results of field examination in 1934 of known gold occurrences. About one-half of the main prospects are sufficiently promising to warrant further exploration.

Rock Wool From Illinois Mineral Resources. Bull. 61. State Geological Survey, Urbana, Ill. Pp. 262. Illustrations 34. Tables 39. Geological and chemical investigations to determine the economic basis of a rock-wool industry in Illinois.

Annual Report of the Director of the Mint (for the fiscal year ended June 30, 1934.) For sale by the Superintendent of Documents, Washington, D. C. Pp. 117. Price 75c.

Thermodynamic Data on Some Metallurgically Important Compounds of Lead and the Antimony Group Metals and Their Applications. By Charles G. Maier. Report of Investigations. U. S. Bureau of Mines, Washington, D. C. Pp. 54.

Mining Methods and Costs at El Potosi Mine, El Potosi Mining Co., Chihuahua, Mexico. By Harlan A. Walker. Information Circular 6804. U. S. Bureau of Mines, Washington, D. C.

Tungsten—Part I. By W. O. Vanderburg. Information Circular 6821, U. S. Bureau of Mines, Washington, D. C. Pp. 31.

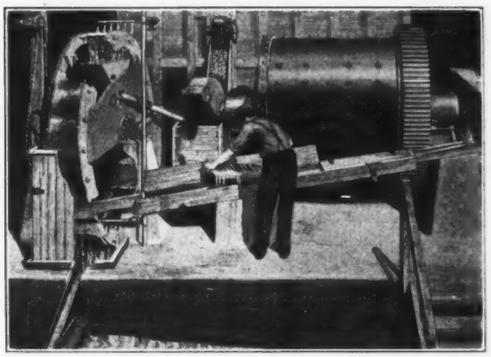
Concentration of the Potash Ores of Carlsbad, New Mexico, by Ore Dressing Methods. By W. H. Coghill, F. D. DeVaney, J. Bruce Clemmer, and S. R. B. Cooke. United States Bureau of Mines Report of Investigation 3271. Pp. 13.

Annual Report of the Under Secretary for Mines, Queensland, Australia, 1933. Brisbane.

Mines of Ontario. Forty-third Annual Report of the Ontario Department of Mines, Toronto, being Vol. XVIII, Part I, 1934. Pp. 153.

West Darling District (New South Wales). A Geological Reconnaissance. By E. J. Kenny. Mineral Resources Bulletin No. 36. Department of Mines, Sydney, Australia. Pp. 180. Supplementary maps.

EQUIPMENT NEWS



Screen-Wheel Classifier Handles Finer Meshes

High Efficiency Claimed—Also Compactness and Low Maintenance

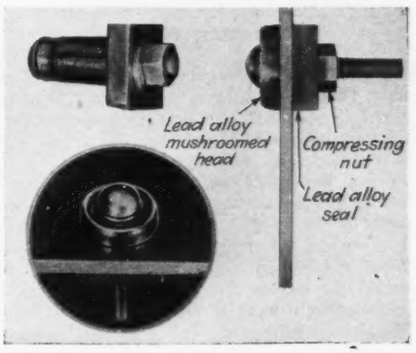
A new classifier, known as the Rib-Cone screen-wheel classifier, has been developed by Straub Manufacturing Company, of Oakland, Calif. Its chief characteristics are compactness, high efficiency, low maintenance cost, and a simple, logical design that is said to extend greatly the field of practical screening into finer meshes previously considered impossible. Like the drag or rake classifier, it is usually placed in closed circuit with a mill of the grid-discharge type.

This new machine consists of a large-diameter, slowly revolving wheel, of squirrel-cage construction and of suitable width, around which the screen is securely fastened by detachable clamps. Adjustable lifter vanes of steel plate are spaced at intervals around the interior of the rim to lift and return the oversize to the mill, and to support the screen cloth. The main supporting bearing is of special design, and is completely sealed against entrance of foreign matter, which also prevents grease or oil from contaminating the ore. The pulp from the mill is fed gently onto the lower part of the wheel, in the same direction of travel as the screen is moving, and over its full width, to reduce abrasion or screen wear and insure maximum capacity. Fines washed through the screen by washing sprays inside the wheel pass direct to amalgamation or concentrating tables, or to flotation machines, and the oversize is elevated by the lifter vanes and discharged into the stationarv hopper inside the upper half of the screen wheel, whence it flows by gravity to the mill. Screen wear is practically nil, as the elevating of the oversize is done by the lifter vanes, and not by the screen cloth of the wheel.

The machine delivers a perfectly sized product containing no oversize, and returns to the mill a clean washed oversize containing practically no fines. Absence of vibration and abrasion are other factors that make for low maintenance costs. Operating records show that the screen cloth expense has been reduced to a very low figure. Approximately a 1-hp. motor is required to drive the larger machines.

Tank Leaks Quickly Plugged By Soft Alloy Seal

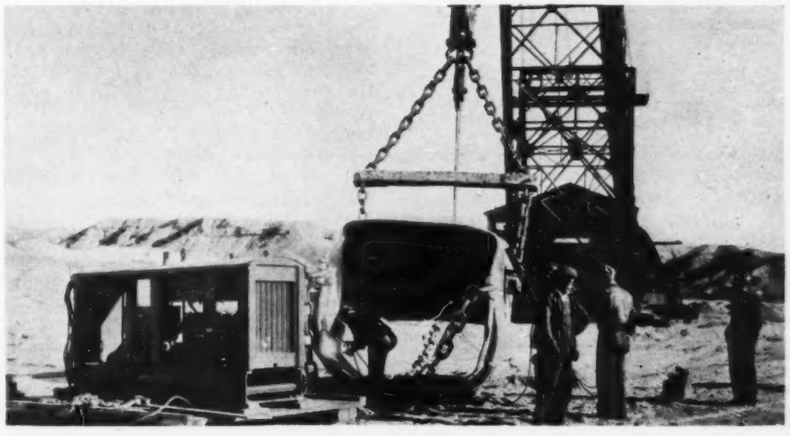
A device for repairing holes, cracks, or similar causes of leaks in tanks or other containers holding air, water, or oil has been introduced by the Multi-Seal Manufacturing Company, Box 3900, Chicago. It is shown in the accompanying illustration. It forms three seals that will withstand 2,000-lb. pressure and temperatures up to its fusing point, which is 900 deg. F. It consists essentially of an anchor bolt having directly beneath its head and surrounding its shank a piece of ductile lead alloy of about the same diameter as the head, and between this and the hexagonal nut on the bolt's opposite end a square washer-like piece of the same lead alloy. The entire plug is inserted bolt head foremost through the hole to be repaired, until the square washer-like piece of alloy comes up against the outer surface of the container. The nut is then taken up with a wrench, the resulting pressure causing the piece of soft



Three views of the plug. That in the upper left shows the plug as it is inserted through the hole to be filled

New Hard-surfacing Rod Gives Self-hardening Deposit

A new hard-surfacing electrode designed for building up straight carbon steel, low alloy, or high manganese-steel surfaces to resist abrasion has been developed by the Lincoln Electric Company, Cleveland, Ohio. Known as "Abrasoweld," it will be found of particular value in such applications as restoring teeth, lips, and bottoms of power shovels; lugs and treads of tractors; housings and impellers of centrifugal sand pumps; rock-crushing equipment; and gear and pinion teeth. The deposit is self-hardening. An instance of its use is seen at the right.



Dental work for a dragline bucket with hard-surfacing, self-hardening welding rod

alloy beneath the head inside the container to collapse and spread over the inside surface of the container and at the same time to fill up the hole around the shank of the bolt. Thus the hole is effectively plugged by the two pieces of soft alloy. The device is known as the Multi-Seal plug.

Zinc Lathe for Sheets 36 In. Wide

To supply the needs of those operators still using zinc shavings for precipitating gold in cyanide solutions, the Mine & Smelter Supply Company, of Denver, Colo., has introduced several new types of lathes, to accommodate the small as well as the large plant. These are designed to take sheets 36 in. wide, the sheets being wound on an arbor under pressure and the shavings cut by a side tool with automatic feed. The lathe, known as the Massco, has a rigid box-type bed casting, allowing the free discharge of the shavings; a water-cooled arbor, accurately fitted and free running, allowing continuous operation at full capacity; a special tool holder, providing attachment for a pressure sheet-winding device; and an automatic feed, which maintains an accurate setting, producing shavings of from 0.002 to 0.004 in.

Rubber Substitute Resists Oils, Greases, Acids

Remarkable properties are claimed for a new rubber substitute, known as, "Koroseal," by the B. F. Goodrich Company, Akron, Ohio. Although the cost of making it prohibits its adoption at present as a general substitute for rubber, it has characteristics which are said to render it far superior to rubber for certain specialized applications. Despite the fact that it differs from rubber in chemical composition, it may, like rubber, be varied by compounding methods from a very hard to a soft, doughy consistency, and can be molded into any shape. It can also be made in a variety of colors. It is odorless. It has unusual resistance to swelling when exposed to many oils and greases, as well as to disintegration in the presence of corrosive chemicals. It is said to have been shown to be ideal for making piston packing, because of the tight seal around the piston that is afforded by it in the presence of oil. A far greater flexing life and corrosion resistance is claimed for it than for rubber.

Another Gyratory Screen

No vibration is imparted to adjacent structures by a new screen recently introduced by Beardsley & Piper Company, Chicago. This screen is said to operate with a combination of circular, vertical, oblique, and forward-and-backward movement, best described as gyratory. Because of its compactness, minimum headroom, length, and width are afforded. The operating mechanism is sealed against dust. Power required is 1 hp. or less. The screen has wide application.

Gasoline-driven Hammer Improved —Has Many Applications

Prospecting, shallow drilling, breaking rock or concrete, digging frozen ground, tamping back fill, and demolition work are among the applications of the portable gasoline-driven hammer shown in the accompanying cut. In construction, this hammer is essentially an air-cooled, two-cycle, single-cylinder engine, which, when equipped with a drill or digging tool, will strike 1,200 to 1,500 powerful blows per minute. It will accommodate any 1⅛-in. hex. shank tool. It is started by throwing the ignition switch and pushing down on the starting plunger at the top of the cylinder. Fuel used is low-test gasoline. Lubrication is effected by mixing oil with the gasoline and pouring it in the gasoline tank. Normal consumption is about 1 qt. of the mixture per operating hour. The present machine is an improved form of an older model. It is operated by one man and weighs 89 lb. The Barco Manufacturing Company, 1801 Winnemac Ave., Chicago, is the manufacturer.

Breaking up concrete foundations with an improved gasoline-driven hammer

From Cleaning Sand To Washing Gold Gravel

Concentrating tables of the Deister-Overstrom diagonal-deck type having been successfully used in the washing of sand and gravel, as for example in the plant of T. L. Herbert & Sons, of Nashville, Tenn., the Deister Concentrator Company, of Fort Wayne, Ind., which makes them, believes they can be applied perhaps with equal success to the washing of gold-bearing sands and gravels. The table mentioned is said to have demonstrated its ability to handle material up to 2 in. in size, and on this score should interest those engaged in recovering gold from placer deposits.

In construction, this table has a tilting frame and main base of structural steel of adequate section, rigidly braced. The head motion is of strong construction, fully inclosed and running in oil. The deck is built of first-quality, selected and seasoned cypress lumber. Unusual fabrication makes it self-bracing. Its unique design of the diagonal deck is said to give a great deal more actual working area than is to be had through the use of the old-style rectangular deck. Greater capacity and efficiency are said to be the result.

Electric Cap Lamp Headpiece Improved for Comfort

As a desirable improvement in its electric cap lamp the Koehler Manufacturing Company, Marlboro, Mass., offers the new Wheat Model T headpiece with side cord outlet. Advantages pointed out by the company include: lighter weight; greater resistance to the entrance of dust; more headroom through transferring the cord from the top to the side of the hat; greater comfort, due to the fact that the side outlet for the cord allows the headpiece to set lower on and closer to the hat; new and more positive contact arrangement; new and improved bulb switch control; simplified interior assembly; and Wheat automatic lock. The headpiece bears the United States Bureau of Mines approval plate.

This Hammer Drill Lubricated On Flush Principle

A 55-lb. hammer drill (Model L-9) has been developed by the Sullivan Machinery Company, Chicago, to operate under the worst possible conditions with respect to grit and dust. According to the makers, a hammer drill, because of its construction, requires not only lubrication but constant flushing as well. In the new drill this is achieved by a so-called new flush principle of lubrication, which bathes all parts in clean oil and washes out all gritty particles. The drill, equipped with the company's flat "Pancake" valve, is said to use very little air.

Motor-driven Centrifugal Pump In New Sizes

Two larger units have been added to its Monobloc centrifugal pump group by Worthington Pump & Machinery Corporation, Harrison, N. J. These are sizes 3 and 4 in. The pump impeller is mounted directly on the motor shaft and both pump and motor are bolted to one rigid base, thus reliving the pump from possible pipe strain.

Novel D.C.-Type Motor Operates From A.C. Source

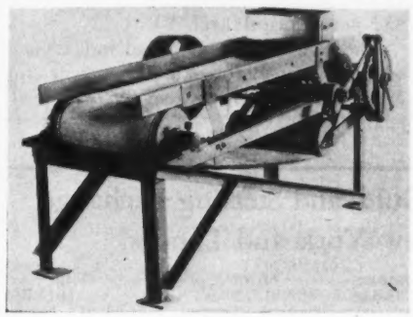
Revolutionary in type is the new electric motor, utilizing a "stationary commutator" and having the characteristics of a series type d.c. machine, although operating from an a.c. power source, which has been developed by E. F. W. Alexanderson, consulting engineer of the General Electric Company. Known as a "Thyratron" motor, the new development is made possible by recent advances in the application of electron tubes. Announcement was made in a paper

presented by Dr. Alexanderson and A. H. Mittag, also with the General Electric Company, at the A.I.E.E. convention in New York.

One motor of this type, intended for use in driving an induced fan, has already been built and is now on test in the company's Schenectady works. It is rated 400 hp. at 625 r.p.m., and 75 hp. at 350 r.p.m. These are the specified ranges of horsepower and speed for the particular application, although the motor may be successfully controlled down to standstill, if required. The equipment operates from a 2,300-volt, three-phase, 60-cycle power supply.

Traveling Belt of Corduroy Serves as Gold Catcher

Gold-saving corduroy in the form of a power-driven endless belt which is mounted on the steel framework shown in the accompanying cut constitutes the surface of this so-called "blanket-mat" table, made by the Cottrell Engineering



An endless adjustable belt covered with corduroy is the essential feature of this gold-saving machine

Company, Los Angeles. The cloth used has ribbed edges to prevent overflow and is cemented to the underlying belt. It is easily replaced when worn. Pulp is fed at a point 2 or 3 ft. from the upper end, where the wash-water launder is situated. Speed of travel can be regulated to suit the pulp; likewise the tilt of the table. The machine is so built that the cloth will move lengthwise or sideways and is made in sizes 2x6 ft. to 3x16 ft. According to the manufacturer, it has been found effective where the concentrate forms a large percentage of the pulp fed to it.

Blueprint Machine Uses New Angstrom Lamp

In a blueprint machine which has recently been introduced by Milligan & Wright Company, 4614 Prospect Ave., Cleveland, Ohio, the new Angstrom blueprint lamp is being used. This lamp is of the incandescent type, and as such is said to offer many advantages over the conventional arc and mercury vapor lamp. It operates from the regular 110 to 115 d.c. or a.c. lighting circuit without requiring transformer choke coils and the like. It differs from the ordinary incandescent lamp, in that the quality of the light produced is stronger in the blue end of the spectrum.

All-Welded Bucket Strong and Light

A new light-weight bucket, designed to reduce dead weight to a minimum and at the same time provide great strength through all-welded construction, has been announced by Harnischfeger Corporation, Milwaukee. The features are combined with that of a smoother inside surface. Bottom, sides, and back are formed by a single heavy steel plate securely seamed at the back and with a heavy angle reinforcement mounted around the entire upper edge for additional rigidity. Four forged wearing shoes or runners are welded to the bottom to take the wear from the bucket shell. Arc and side reinforcements are fabricated as a single unit with the lip plate, the latter being 2 in. thick and capable of taking the punishment of a much heavier bucket.

Turbo-Blower Geared

Compactness is obtained in a new centrifugal compressor or turbo-blower by driving it with a Gearmotor, the combination being introduced by Allis-Chalmers Manufacturing Company, Milwaukee. Use of this means for increasing the speed makes it possible to run the blower at higher than motor speeds, thus reducing its dimensions and improving performance. Pressures from 0.75- to 3-lb. gage are developed, the volumetric capacities corresponding to motor outputs from 3 to 30 hp.

Jack for Pulling Cars, Shifting Track

A pulling jack that weighs approximately 100 lb. and is 36 in. by 10 in. wide and is constructed of high quality steel, with pawls of chrome steel, is offered for a variety of purposes by Pierce-Miller & Company, Brazil, Ind. Among many practical applications, it is recommended for such tasks as spotting cars, putting up derricks, moving machinery, erecting structural steel, pulling well casings, tightening guy ropes, moving power-shovel track, and assembling and disassembling shovels and draglines. It consists essentially of a drum operated by a pawl and ratchet by means of a lever.

Recently Developed Flow Meter In New Hands

The flow meter known as the Isometer has been taken over by the Elgin Softener Corporation, Elgin, Ill. This instrument uses a variable-orifice principle of operation for the measurement of steam, water, oil, and other liquids and gases. It was developed by the Isometer Corporation, of Milwaukee.

Cheaper Operation Claimed for This Portable Compressor

Recently two-stage, air-cooled portable compressor has been added to Ingersoll-Rand's line of "portables." It is known as the Model 85 and is driven by a Waukesha gasoline engine. Its capacity is 85 cu.ft. per minute at 100 lb. It has two low-pressure, air-cooled cylinders and one high-pressure air-cooled cylinder, and an air-cooled intercooler. According to the builder, the air cooling, two-stage compression, intercooling, and certain manufacturing refinements all combine to make a saving of up to 25 per cent over the fuel cost of water-cooled, single-stage portable compressors; furthermore, two-staging gives increased efficiency at high altitudes and in hot climates over single-stage units.

An Improved Lubricant For Air Drills

A new fluid grease for air drills, which is known as C. P. No. 5, has been introduced by the Keystone Lubricating Company, Philadelphia. Where the air is wet, it is said to offer a durable piston seal. It is said to be able to stand up under severe operating conditions and to possess great adhesiveness, which enables it to stick to the adjusting screw under all conditions. In cold test and melting point, and in its ability to prevent fogging under unusual conditions, it is reported to be satisfactory. It works well through a line oiler and tends to atomize quickly, yet holds enough body to carry through to the far end of the drill and give satisfactory lubrication to all working parts.

Bulletins

Traveling Cranes. Whiting Corporation, Harvey, Ill. Bulletin 195. Hand power and electric cranes. Pp. 4.

Magnetic Pulleys and Separators. Magnetic Manufacturing Co., Milwaukee, Wis. Bulletin 300.

Lubrication of Mine Locomotives. Standard Oil Co. (Indiana), Chicago. Descriptive bulletin. Pp. 8.

Motorized Reducers. Link-Belt Co., Chicago. Catalog 1515. Pp. 20.

"Superior" Hollow Drill Steel. Bethlehem Steel Co., Bethlehem, Pa. Booklet 83. Pp. 20.

Vibrating Screen. Smith Engineering Works, Milwaukee, Wis. Bulletin 066-J. Heavy-duty Pulsator. Pp. 7.

Bucket Elevators. Jeffrey Mfg. Co., Columbus, Ohio. Catalog 565. Pp. 112.

Boltless Ball Mill. American Ball Mill Co., Denver, Colo. Bulletin J1. Folder.

Gears and Sprockets. Medart Company, St. Louis, Mo. Catalog. Pp. 80.

Centrifugal Fire Pumps. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin W 320-B1. Pp. 4.

Calyx Core Drills. Ingersoll-Rand Co., New York. Catalog. Pp. 48.

Dust Removal. U. S. Hoffman Machinery Corp., New York. Heavy-duty vacuum cleaning equipment. Pp. 16.

Air Filters. Coppus Engineering Corp., Bulletins F-320-3 and F-320-2. (The company announces the cancellation of its agreement with Mr. Annis under which it has been manufacturing air filters for the last three years.)

H. K. Porter Fireless Locomotives, Direct and Geared. Wonham, Inc., 44 Whitehall St., New York. Pp. 16.

Electric Equipment for Power Shovels. General Electric Co., Schenectady, N. Y. Pp. 20.

Denver Thickeners. Denver Equipment Co., Denver, Colo. Bulletin 3512-A. Also bulletins on the Wheeler-type clean-up pan and the mechanical gold pan. Each 2 pp.

Concrete Form Construction. Wheeler Osgood Sales Corp. Bulletin 4-D-2. Laminex Plyform. Pp. 10.

Beco-Turner Baffles. Plibrico Jointless Firebrick Co., Chicago (The Boiler Engineering Co., of Newark, formerly the builder of these baffles, has discontinued business). Pp. 8.

Noise and Vibration Control. Cork Insulation Co., New York. Corinco isolation board.

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

OUTSTANDING in developments during the last month was the satisfactory conclusion of the international copper conference in New York. The drastic curtailment agreed upon—240,000 tons a year from current production outside of the United States—was largely responsible for heavy buying abroad and a rising foreign quotation. As the month of March ended, our f.o.b. refinery quotation for export copper was 7.100c., against 6.375c. at the close of February. The low for 1934 was 6.075c., Oct. 10th. Though the brunt of the impact for curtailing output will fall upon the important South American and African properties, the general agreement on trade practices governing sales, according to observers, should about offset the sacrifices on production made by these groups. Operations in copper can be checked closely under the new plan, and an orderly market for the metal is anticipated.

Sales of "Blue Eagle" copper in the domestic market held at about the same daily rate as in the preceding month; a total of 32,303 tons in March against 29,456 tons in February. It was announced in Washington that Section 6 of Article VII of the Copper Code, relating to sales quotas, is to be amended, and a hearing is scheduled for April 16. The domestic quotation continued at 9c., Valley, throughout the month. Unless demand here improves considerably, it is believed that an advance in the domestic price is not likely to occur in the near future.

Lead buying was in sufficient volume to bring about a modest 10-point advance in prices. Refined lead stocks in the United States at the end of February totaled 226,799 tons, a decrease of 5,129 tons from the total on hand a month previous.

Curtailment in domestic production of zinc became a fact last month, and the price of Prime Western advanced 10 points. Buying was moderately active, with the tone firm.

Tin presented the one weak spot in base metals. Buying was fair at the lower prices. Continued unsettlement in London quotations was caused by uncertainty over the future marketing policy of the tin group.

On March 26, the open-market quotation for silver was 61¼c., the highest price since June 1, 1928. Cadmium advanced to 65c. Platinum was lowered to $32 per ounce March 14.

The *E. & M. J.* weighted index number of non-ferrous metal prices for March was 71.36, against 69.97 in February.

United States Market

Mar.	Electrolytic Copper Domestic (a)	Electrolytic Copper Export (b)	Straits Tin New York (c)	Lead New York	Lead St. Louis	Zinc St. Louis
1	9.00	8.775	6.450	47.750	3.55	3.40	3.825@3.875
2	9.00	8.775	6.475	47.600	3.55	3.40	3.850
4	9.00	8.775	6.475	47.250	3.55	3.40	3.850@3.875
5	9.00	8.775	6.425	47.250	3.55	3.40	3.850@3.900
6	9.00	8.775	6.400	46.750	3.55	3.40	3.900
7	9.00	8.775	6.375	46.800	3.55	3.40	3.900
8	9.00	8.775	6.400	47.500	3.55	3.40	3.900
9	9.00	8.775	6.400	47.250	3.55	3.40	3.900
11	9.00	8.775	6.400	46.950	3.55	3.40	3.900
12	9.00	8.775	6.400	46.750	3.55	3.40	3.900
13	9.00	8.775	6.350	47.125	3.55	3.40	3.900
14	9.00	8.775	6.300	47.000	3.55	3.40	3.900
15	9.00	8.775	6.325	47.100	3.55	3.40	3.900
16	9.00	8.775	6.350	47.200	3.55	3.40	3.900
18	9.00	8.775	6.375	46.100	3.60	3.45	3.900
19	9.00	8.775	6.350	45.750	3.60	3.45	3.900
20	9.00	8.775	6.400	46.000	3.60	3.45	3.900
21	9.00	8.775	6.450	45.700	3.60	3.45	3.900
22	9.00	8.775	6.500	45.850	3.60	3.45	3.900
23	9.00	8.775	6.600	46.250	3.60	3.45	3.900
25	9.00	8.775	6.725	47.250	3.60	3.45	3.900
26	9.00	8.775	6.800	47.400	3.60	3.45	3.900
27	9.00	8.775	6.850	47.550	3.60	3.45	3.900
28	9.00	8.775	6.925	47.625	3.65	3.50	3.900
29	9.00	8.775	7.075	47.700	3.65	3.50	3.900
30	9.00	8.775	7.100	47.550	3.65	3.50	3.900
Av. for month		8.775	6.526	46.962	3.579	3.429	3.894
Averages for Week							
6		8.775	6.433	47.325	3.550	3.400	3.860
13		8.775	6.388	47.063	3.550	3.400	3.900
20		8.775	6.350	46.525	3.575	3.425	3.900
27		8.775	6.654	46.667	3.600	3.450	3.900
Calendar Week Averages							
2		8.775	6.321	47.667	3.550	3.400	3.804
9		8.775	6.413	47.133	3.550	3.400	3.890
16		8.775	6.354	47.021	3.550	3.400	3.900
23		8.775	6.446	45.942	3.600	3.450	3.900
30		8.775	6.913	47.513	3.625	3.475	3.900

Silver, Gold, and Sterling Exchange New York and London

Mar.	Sterling Exchange "Checks"	Sterling Exchange "90-day Demand"	Silver (d) New York	Silver (d) London	Gold London	Gold (e) United States
1	4.83625	4.83375	56.8750	26.0625	145s 1 d	$35.00
2	4.77750	4.77375	57.8750	27.0000	146s 10½d	35.00
4	4.75500	4.75250	58.0000	27.1250	148s 10 d	35.00
5	4.77625	4.77375	57.7500	26.6875	147s 10½d	35.00
6	4.76000	4.75625	57.6250	26.8125	149s 4 d	35.00
7	4.75000	4.74625	58.3750	27.2500	148s 10 d	35.00
8	4.78000	4.77750	58.7500	27.0000	148s 3½d	35.00
9	4.77125	4.76875	58.5000	26.9375	147s 5½d	35.00
11	4.77500	4.77250	58.7500	27.1875	148s 4 d	35.00
12	4.74375	4.74250	58.6250	27.1875	147s 6 d	35.00
13	4.74250	4.74000	58.6250	27.3125	148s	35.00
14	4.75250	4.75000	58.8750	27.3750	147s 8 d	35.00
15	4.79000	4.78750	59.1250	27.3125	146s ½d	35.00
16	4.79875	4.79625	58.8750	27.1250	145s 5 d	35.00
18	4.76000	4.75750	58.8750	27.3750	146s 11 d	35.00
19	4.76750	4.76500	58.8750	27.3125	147s 2½d	35.00
20	4.76750	4.76500	58.8750	27.1250	145s 6 d	35.00
21	4.76125	4.75875	58.7500	27.1875	146s 10½d	35.00
22	4.77125	4.76875	59.0000	27.1875	146s 5½d	35.00
23	4.76750	4.76500	59.0000	27.3750	146s 1 d	35.00
25	4.77750	4.77500	60.0000	27.8750	145s 7½d	35.00
26	4.78250	4.78000	61.2500	28.8750	145s 7 d	35.00
27	4.79375	4.79125	61.0000	28.4375	145s 3 d	35.00
28	4.80125	4.79875	61.0000	28.3750	144s 10½d	35.00
29	4.83625	4.83250	60.7500	27.8750	143s 8 d	35.00
30	4.79000	4.78625	61.2500	28.5000	145s 1 d	35.00
Av. for month	4.77635	.....	59.048	27.380	.....	35.00
Averages for Week						
6	4.79250	.....	57.438	.....	.....	.....
13	4.76042	.....	58.604	.....	.....	.....
20	4.77271	.....	58.917	.....	.....	.....
27	4.77563	.....	59.833	.....	.....	.....

Calendar week averages: New York Silver, Mar. 2d, 56.396; 9th, 58.167; 16th, 58.813, 23rd, 58.896; 30th, 60.875.

(a) Quotation issued by the Code Authority for copper offered for sale in the domestic market pursuant to the provisions of the Copper Code.

(b) Net prices at refineries on the Atlantic seaboard, being Code Authority prices, less delivery and interest charges of 0.225c. per lb. which is the average differential for delivery in New England.

(c) Export quotations for copper are net prices at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. The c.i.f. Hamburg, Havre, and Liverpool basis commands a premium of 0.300c. per lb. above our f.o.b. refinery quotation.

Excepting "Blue Eagle" copper, the above quotations are our appraisal of the major United States markets, based on sales reported by producers and agencies. All prices are in cents per pound.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is quoted at 0.35c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(d) Silver other than newly mined domestic. Under Executive order issued Dec. 21, 1933, the U. S. Government price on newly mined domestic silver was established at 64½c. per troy ounce.

(e) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

Mar.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic Bid	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
1	27.8750	28.1875	31.0000	220.0000	215.2500	10.2500	10.5625	11.3750	11.6875
4	28.3750	28.7500	31.5000	219.5000	215.2500	10.3125	10.6250	11.5625	11.8125
5	28.0625	28.4375	31.2500	218.5000	213.6250	10.2500	10.5000	11.5000	11.8125
6	28.0000	28.3125	31.2500	215.2500	212.0000	10.3125	10.6250	11.5000	11.8125
7	28.0000	28.3125	31.0000	216.0000	213.0000	10.3750	10.6250	11.5000	11.7500
8	28.0625	28.3750	31.2500	217.5000	213.7500	10.3750	10.6250	11.5000	11.7500
11	28.2500	28.6250	31.2500	217.0000	212.5000	10.4375	10.6875	11.5000	11.7500
12	27.8750	28.2500	31.0000	218.7500	213.7500	10.3750	10.6250	11.5625	11.8125
13	27.6875	28.0625	31.0000	219.0000	214.5000	10.5000	10.7500	11.6250	11.8750
14	27.4375	27.7500	30.5000	220.5000	215.5000	10.5000	10.8125	11.6875	11.8750
15	28.0625	28.3125	31.0000	215.5000	210.7500	10.5625	10.8750	11.8125	12.0625
18	28.0000	28.3750	31.0000	212.5000	208.5000	10.8750	11.1250	12.0625	12.25o8
19	27.9375	28.3125	31.0000	208.0000	204.5000	10.6875	10.9375	11.9375	12.1250
20	28.0000	28.3750	31.0000	210.7500	207.5000	11.0000	11.1875	12.0625	12.1875
21	28.5000	28.8750	31.5000	209.5000	206.2500	11.6875	11.6875	12.6875	12.6875
22	28.6875	29.0625	31.7500	212.5000	208.7500	12.0625	12.0625	12.6875	12.6875
25	29.4375	29.8125	32.5000	215.5000	211.0000	12.2500	12.3125	13.1875	13.1875
26	29.6875	30.0625	32.7500	216.0000	211.7500	12.3125	12.3125	13.2500	13.2500
27	30.1250	30.5625	33.2500	216.2500	212.5000	12.1250	12.1250	13.1250	13.0000
28	30.1875	30.5625	33.2500	216.0000	212.8750	12.0000	12.0000	13.0000	13.0000
29	30.6250	31.0000	33.7500	215.7500	212.2500	12.0000	11.8750	12.8750	12.8750
Av. for month	28.518	.....	31.607	215.726	.....	11.012	11.188	12.095	12.250

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(April 1, 1935)

Miscellaneous Metals

Aluminum, ingot, 99 per cent plus, lb.	19@21c.
Antimony, domestic or Chinese (duty paid), lb.	14½c.
Bismuth, ton lots, lb.	$1.10
Cadmium, lb.	65.00c.
Chromium, 97 per cent grade, lb.	88.00c
Nickel, electrolytic cathodes, lb.	35.00c.
Magnesium, 99.8 per cent, carloads, lb.	30.00c.
Palladium, troy oz.	$24.00
Platinum, (official quotation) troy oz.	$32.00
Quicksilver, flask of 76 lb., 100 flasks or more	$72.50
Radium, mg. radium content	$50.00
Selenium, 99.5 per cent, lb.	$2.00
Silicon, minimum 97 per cent spot, lb.	16.50c.
Tellurium, lb.	$2.00
Thallium, 100 lb. or more, lb.	$6.50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton	$16.00@$16.50
Iron Ore, Lake Superior, long ton:	
Old Range bessemer	$4.80
Mesabi bessemer	$4.65
Old Range, non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent, Joplin, Mo., ton	$35.00
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52@55 per cent	26c.
49@51 per cent	25c.
44@47 per cent	24c.
Molybdenum Ore, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$16.50
Domestic Scheelite	$16.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$26.00

Metallic Compounds

Arsenious Oxide (arsenic) lb.	3½c.
Cobalt Oxide, 70@71 per cent, lb.	$1.35
Copper Sulphate, 100 lb.	$3.85
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb.	$1.24
Sodium Sulphate, bulk, ton	$13.00@$15.00

Alloys

Beryllium-Copper, Master alloy, 3.5 per cent Be, per lb. of contained Be	$25.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb.	10c.
Ferromanganese, 78@82 per cent, gross ton	$85.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, gross ton	$77.50
Ferrotungsten, 75@80 per cent, lb. of W contained	$1.35@$1.45

Non-Metallic Minerals

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$500@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$135
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$45@.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7@.....
Missouri, 95 per cent $BaSO_4$, 1 per cent iron	$5@.....
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a)$4.50@ $6.00
French, 56@59 per cent	(a)$5.50@ $6.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$6.00@ $7.50
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.50
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	$13.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½x2in.	15@30c.
2x2in.	30@50c.
2x3in.	50@65c.
3x4in.	90@ $1.25
4x6in.	$1.50@ $2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@ 12½c.
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$16.00@.....
200 mesh, cream colored	$26.00@.....

(a) Nominal

Iron and Steel

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$19.00
Basic	$18.00
No. 2 Foundry	$18.50
Steel, base prices, Pittsburgh:	
Billets gross ton	$27.00
Structural shapes, 100 lb.	$1.80
Bars, 100 lb.	$1.80

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1934	1935	1934	1935	1934	1935
January	44.188	54.418	19.382	24.584	504.644	489.207
February	45.233	54.602	20.073	24.818	503.085	487.278
March	45.875	59.048	20.278	27.380	509.259	477.635
April	45.180	.....	19.740	.....	515.210	.....
May	44.226	.....	19.276	.....	510.510	.....
June	45.173	.....	19.981	.....	504.721	.....
July	46.310	.....	20.512	.....	503.990	.....
August	48.986	.....	21.377	.....	506.398	.....
September	49.484	.....	21.888	.....	499.344	.....
October	52.375	.....	23.581	.....	494.019	.....
November	54.255	.....	24.257	.....	498.832	.....
December	54.390	.....	24.404	.....	494.520	.....
Year	47.973	.....	21.229	.....	503.711	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery, Electrolytic			London Spot			
	Domestic		Export	Standard		(a) Electrolytic	
	1934	1935	1935	1934	1935	1934	1935
January	7.890	8.775	6.583	32.560	28.077	35.614	31.261
February	7.777	8.775	6.341	33.072	27.175	35.969	30.244
March	7.775	8.775	6.526	32.497	28.518	35.512	31.607
April	8.173	.....	.....	33.006	.....	36.038	.....
May	8.275	.....	.....	32.662	.....	35.756	.....
June	8.594	.....	.....	32.149	.....	35.339	.....
July	8.775	.....	.....	29.707	.....	32.778	.....
August	8.775	.....	.....	28.358	.....	31.483	.....
September	8.775	.....	.....	27.541	.....	30.556	.....
October	8.775	.....	.....	26.753	.....	29.478	.....
November	8.775	.....	.....	27.233	.....	30.222	.....
December	8.775	.....	.....	27.836	.....	31.086	.....
Year	8.428	.....	.....	30.281	.....	33.319	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

Lead

	New York		St. Louis		London			
	1934	1935	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.000	3.692	3.900	3.542	11.304	11.517	10.321	10.514
February	4.000	3.528	3.900	3.378	11.634	11.913	10.216	10.413
March	4.000	3.579	3.900	3.429	11.545	11.842	11.012	11.188
April	4.179	.....	4.042	.....	11.500	11.794	.....	.....
May	4.140	.....	3.990	.....	11.051	11.341	.....	.....
June	3.975	.....	3.825	.....	11.054	11.253	.....	.....
July	3.772	.....	3.623	.....	10.813	11.045	.....	.....
August	3.747	.....	3.597	.....	10.821	11.028	.....	.....
September	3.685	.....	3.535	.....	10.388	10.613	.....	.....
October	3.654	.....	3.504	.....	10.359	10.554	.....	.....
November	3.567	.....	3.417	.....	10.432	10.597	.....	.....
December	3.604	.....	3.454	.....	10.316	10.500	.....	.....
Year	3.860	.....	3.724	.....	10.935	11.166	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	Straits, New York		Standard, Spot, London	
	1934	1935	1934	1935
January	51.891	50.916	226.631	231.193
February	51.668	50.063	226.731	227.381
March	53.838	46.962	233.863	215.726
April	55.622	.....	239.181	.....
May	53.541	.....	234.239	.....
June	51.271	.....	226.875	.....
July	51.930	.....	230.381	.....
August	51.953	.....	228.114	.....
September	51.503	.....	229.888	.....
October	50.951	.....	230.587	.....
November	51.227	.....	228.602	.....
December	50.902	.....	228.178	.....
Year	52.191	.....	230.273	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.271	3.730	14.688	14.943	11.994	12.207
February	4.384	3.714	14.844	15.125	11.819	12.000
March	4.368	3.894	14.735	15.033	12.095	12.250
April	4.370	.....	14.916	15.200	.....	.....
May	4.346	.....	14.722	14.966	.....	.....
June	4.240	.....	14.241	14.467	.....	.....
July	4.317	.....	13.466	13.693	.....	.....
August	4.281	.....	13.682	13.756	.....	.....
September	4.049	.....	12.644	12.847	.....	.....
October	3.832	.....	12.217	12.353	.....	.....
November	3.732	.....	12.000	12.281	.....	.....
December	3.711	.....	11.730	12.016	.....	.....
Year	4.158	.....	13.657	13.890	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1934	1935	(a) 1934	(b) 1935
January	55.000	55.000	23.300	20.000
February	55.000	55.000	23.300	20.000
March	55.000	58.462	23.300	20.000
April	55.000	.....	23.300	.....
May	55.000	.....	23.300	.....
June	55.000	.....	23.300	.....
July	55.000	.....	23.300	.....
August	55.000	.....	23.300	.....
September	55.000	.....	23.300	.....
October	55.000	.....	23.300	.....
November	55.000	.....	23.300	.....
December	55.000	.....	23.300	.....
Year	55.000	.....	23.300	.....

Aluminum in cents per pound, 99 per cent grade. (a) Based on Aluminum Company's quotation. (b) Open market price.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1934	1935	1934	1935	1934	1935
January	7.198	14.111	67.538	72.760	38.000	34.000
February	7.172	14.250	72.011	72.500	38.000	34.000
March	7.545	14.250	75.472	72.500	38.000	32.846
April	7.918	.....	75.930	.....	38.000	.....
May	8.465	.....	75.577	.....	36.538	.....
June	7.900	.....	75.000	.....	36.000	.....
July	8.024	.....	75.000	.....	36.000	.....
August	8.514	.....	75.000	.....	36.000	.....
September	8.745	.....	74.563	.....	36.000	.....
October	9.361	.....	74.000	.....	35.038	.....
November	12.239	.....	73.283	.....	35.000	.....
December	13.730	.....	73.000	.....	35.000	.....
Year	8.901	.....	73.865	.....	36.465	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1934	1935	1934	1935	1934	1935
January	18.00	19.00	17.00	18.00	17.50	18.50
February	18.00	19.00	17.00	18.00	17.50	18.50
March	18.00	19.00	17.00	18.00	17.50	18.50
April	18.48	.....	17.48	.....	17.98	.....
May	19.00	.....	18.00	.....	18.50	.....
June	19.00	.....	18.00	.....	18.50	.....
July	19.00	.....	18.00	.....	19.50	.....
August	19.00	.....	18.00	.....	18.50	.....
September	19.00	.....	18.00	.....	18.50	.....
October	19.00	.....	18.00	.....	18.50	.....
November	19.00	.....	18.00	.....	18.50	.....
December	19.00	.....	18.00	.....	18.50	.....
Year	18.707	.....	17.707	.....	18.207	.....

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces

H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

A. W. FISHER
Manager

Published by McGraw-Hill Publishing Co., Inc.

WILLARD CHEVALIER
Vice-President

"My Feet Slid About, I splashed into a heavy liquid, and had the utmost difficulty in lifting my boots, which seemed weighted down with lead. I struck a match, and found I was in quicksilver almost up to my knees. Here the element runs free in the matrix, and trickles from the walls like water. . . . Outside once more, I had to pull off my boots and pour out from each a cupful of quicksilver," so writes an author in the April issue of *Westways* concerning a recent visit that he made to the abandoned Socrates mine near Clear Lake, Calif. Perhaps a visit to the Rock Candy Mountains with Baron Munchausen would yield equally interesting material for an article on the confectionery industry.

●

American Chemical Industry was 300 years old last month. At least the American Chemical Society celebrated the tercentenary of American chemistry at a notable convention in New York April 22-27. It seems that in 1635 John Winthrop, Jr., first colonial Governor of Connecticut, started an extensive program of production of salt, glass, potash, alum, and other chemicals, as well as iron, lead, and copper. About 5,000 chemists convened for the celebration to make the country "chemistry conscious."

●

Russian Gold Production is still an unknown quantity that is puzzling mineral economists and monetary authorities throughout the world. It is known to be substantial, perhaps enough to put the U.S.S.R. in second place among gold-producing countries. But how much? Next month we expect to publish an article on the subject that will give at least a clue to the exact answer.

CONTENTS FOR MAY 1935

Volume 136 . . Copyright 1935 . . Number 5

Editorial 213

Work-Relief for the Mineral Industries... 214
Staff Interpretation

Big Canyon's Surface Plant 216
John B. Huttl

Hoisting With Combination Cage and Skip 220
W. S. Maguire

Fatty Acid and Soap Flotation..... 221
Maurice Rey

Maintaining Ore Flow Through Bins..... 223
L. Douglass Anderson

New Stack for Salt Lake Valley..... 227
C. C. Burt

Detachable Bits Cut Drilling Costs..... 229

How to Make an Alignment Chart..... 230
C. E. Heinz

Mounting Concentrate for Microscopic Study 233
Paul H. Bird

Blasting With Safety Primers..... 235
Thomas Soule

Native Mercury in Mexico..... 237
W. Ernest Franks

Equipping the Shop at Small Mines..... 238
Frank W. Gravlin

Corrosion-Proof Reagent Feeder..... 241

News of the Industry 242

Personal Items, Obituaries, Letters..... 255

Book Reviews 258

Equipment News 259

Summary of the Markets..... 262

Invention Note. If you insist on inventing something, says *Business Week*, invent some little gadget. Inventors of the airplane, telephone, and automobile made no great fortunes. But the collar button with the turndown clip, the peg golf tee, and the metal cap for the beverage bottles made millions for their inventors. Also it is well not to be too far ahead of the times. A streamlined train, much like today's design, was patented in 1865.

●

Tin Production has begun for the first time in the province of San Juan, Argentina, at the rate of 30 tons per month recovered from alluvial deposits. The metal is smelted in Buenos Aires and is consumed in the country, which has a demand of about 100 tons per month. Equipment for the mining operation was bought in the United States.

●

Safety Note. National Safety Council estimates that twice as many accidental deaths occurred in the homes of the United States in 1934 as in factories—33,000 as against 15,500. This is not an argument for remaining at work instead of going home, but it does suggest the advisability of watching your step when you get there.

●

Latest Assault on the reliability of the time-honored fire assay for gold comes from a Western chemist who finds "high values" in ores that yield little or no gold by the customary method. According to newspaper reports, the "process is electro-chemical-catalectical (*sic*), involving reintegration of gold atoms split up by ages of constant bombardment of cosmic rays." So there's the culprit. Science is making life more and more complex and difficult.

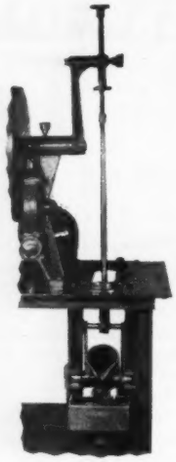
ENGINEERING AND MINING JOURNAL is published monthly by the McGraw-Hill Publishing Company, Inc., 330 West 42d St., New York, N. Y., U. S. A. Subscription rates, United States, $3 per annum; Canada and other countries in the Americas outside the United States, $4 per annum; elsewhere $5 or 20 shillings per annum. Price per copy 50 cents or 2s. Entered as second-class matter June 20, 1879, at the Post Office, New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

McGRAW-HILL PUBLISHING COMPANY, INC.
330 West 42d St., New York, N. Y.
Cable Address: McGraw-Hill, N. Y.
San Francisco: 883 Mission Street
Chicago: 520 North Michigan Avenue
Washington, D. C.: National Press Building

NRA CODE GRAPHIC ARTS INDUSTRY

McGRAW-HILL PUBLISHING COMPANY, LTD.
Aldwych House, Aldwych,
London, W.C.2, England
Cable Address: Backlash, Estrand, London

JAMES H. McGRAW, Chairman of the Board; MALCOLM MUIR, President; JAMES H. McGRAW, JR., Vice-President and Treasurer; B. R. PUTNAM, Secretary.
Printed by The Schweinler Press, N. Y.



A SIP

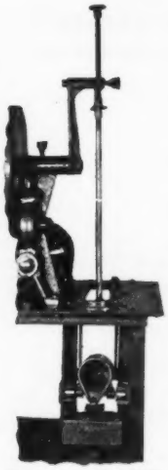
IF A LITTLE IS GOOD

It Does Not Follow That

A LOT IS BETTER

. . . but

GEARY REAGENT FEEDERS



OR A GULP

Are recognized as the finest equipment obtainable for the *accurate control* of reagents in large or small amounts.

The kind and quantity of reagents for a given treatment are determined by preliminary laboratory testing followed by plant adjustments to meet operating conditions.

Our experience of more than 30 years in milling work is available to you through specialized services in ore testing—plant designing—construction—operation. This experience on hundreds of ores from all over the world has given us that qualification commonly called *good judgment*—applied to your problem this means *greater profits* to you.

BEE TEE TILTING FILTER

THE NEW BEE TEE TILTING FILTER

Is in operation and meeting every requirement.

Semi-automatic in operation, low in cost, it meets the needs of the small mill.

Built in three sizes to filter from 1 to 8 tons per 8 hours.

Additional Tested and Proven Equipment of Our Manufacture Includes:—

AGITAIR FLOTATION MACHINES
BEE TEE GOLD TRAPS
BEE TEE CONDITIONERS
BATEA CLEAN-UP AMALGAMATION PANS
GEARY-JENNINGS SAMPLERS
LABORATORY ORE DRESSING EQUIPMENT

Write for Details on Our Service and Equipment

There is no substitute for
EXPERIENCE and SERVICE

THE GALIGHER COMPANY

230 SO. W. TEMPLE ST. (Established 1901) **SALT LAKE CITY, UTAH**

BOOTH-THOMPSON DIVISION